EDITORIAL

THE success of the Russians in landing a vehicle on the moon, and later in sending one around it, naturally created much interest at the I.T.U. Conference at Geneva.

The Russian delegates received universal congratulations from a gathering of engineers, who naturally appreciated the vital part played by radio communication and control systems in such performances.

These have demonstrated beyond doubt that there is no longer any fundamental problem in the control and guidance of space vehicles. In fact, the methods employed have been so successful that the Russians themselves consider them relatively simple.

The implications of the Russian success were not lost on the conference which, among other matters, was scheduled to discuss the allocation of frequencies for space communication. There could have been no more effective way in which to emphasise the fact that, far from being a figment of imagination or colourful speculation, organisation for the movement of space vehicles and even transportation is one of immediate concern.

Proof that the matter is being treated with great seriousness is demonstrated by the fact that determination and discussion of space frequencies has been removed from the routine schedule of frequency allocation, and will be considered and finalised on a very high level.

It is obvious that, from this point on, we are headed for danger and chaos unless complete agreement can be reached on such a level. It is one thing to send a vehicle aloft, but quite another to do much about it once we have lost control.

And the intentions of those who wield the control is something we can't write into tables, for, if objects in space can be accurately controlled, they can also be used as fearsome weapons.

It is much more pleasant to speculate on the use of satellites as aids in bouncing or relaying communication channels around the world and beyond, something which undoubtedly will be within our grasp before very long. They could provide more reliable paths than now exist, and help solve the congestion problem which threatens our present radio bands.

Fortunately, there are concrete signs that at last the powerful nations of the world are realising their responsibilities, and will approach the new space era knowing fully what it can mean, for better or worse, to the future of the human race.

John Moyle

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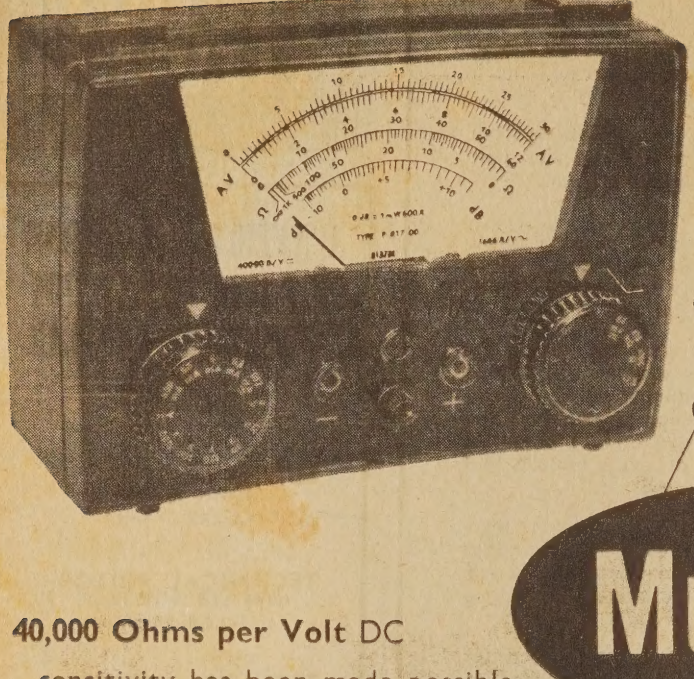
OUR COVER PICTURE

Taken recently at Sydney University's Open Day, this picture shows a model of a De Havilland Dove aircraft in the 7ft x 5ft low-speed wind tunnel. Aeronautical Engineering students are Michael Gregory, 18, of Gordon, N.S.W., and (centre) Fred Sarwoko, a Colombo Plan student from Indonesia.



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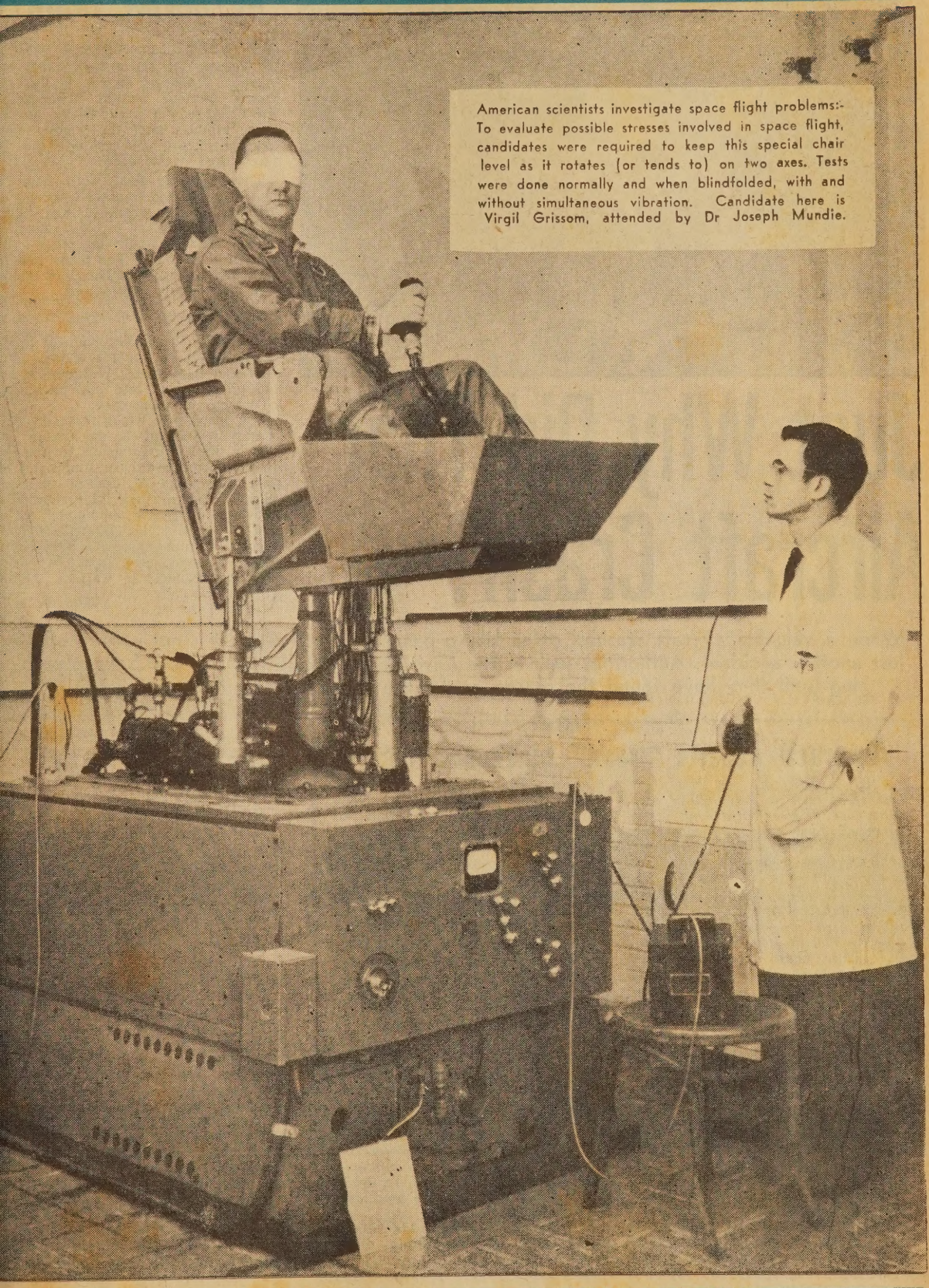
IN TRAINING FOR SPACE FLIGHT



American scientists investigate space flight problems:- To evaluate possible stresses involved in space flight, candidates were required to keep this special chair level as it rotates (or tends to) on two axes. Tests were done normally and when blindfolded, with and without simultaneous vibration. Candidate here is Virgil Grissom, attended by Dr Joseph Mundie.

To the untrained eye, this is just a heap of rubble. For the air-crash expert it holds vital, perhaps decisive clues.

Just Why Did That Aircraft Crash?

When a valuable aircraft crashes, often killing passengers and crew, it is not written off as just another accident. Authorities such as the Civil Aeronautics Board of the U.S. keep probing until they have found the reason and taken steps to prevent its recurrence.

By DEVON FRANCIS

AT 12.17 p.m. on August 4, 1955, th captain of an airliner aloft ov Missouri broadcast an emergency. Th nearest ground station acknowledge the message but received no answe Three minutes later the plane radioe "Springfield, are you reading 476? W have a bad engine fire."

That was the final word from th plane. It crashed minutes later; no or survived. The wreckage was burne rubble.

The accident made no sense. Th weather was good. The plane had ju come from overhaul. The pilot and c pilot were highly experienced.

KNEW CAUSE

Yet within hours Government invest gators, grubbing in the debris, kne what had happened. Within days the had proved their case and taken ste to prevent its recurrence.

The speed with which they solved th mystery was all in the day's work. It their business. Investigators for the Civ Aeronautics Board have found the re sons for scores of crashes in rece years. None of these Government de tectives is a political appointee. All a pilots themselves, including the C.A.B. veteran information officer, Ed Slatter The chief investigator, James N. Peyto once commanded a wartime bombe group.

Air-crash experts "read" blackened debris

CAB investigators say that their best techniques in unravelling accidents are "horse sense and perseverance." That's only part of it. They are also skilled in reading a number of fascinating technical clues. Here are just a few:

Speed at impact? First they look for the impact marks, on a shim plate within each propeller hub, of the gear teeth at the butt of each blade. That gives blade pitch at impact. Then they study the governor setting in the hub, which supplies r.p.m. Finally, they measure the distance between successive slash marks made by the blades along the ground. Read together, these clues tell not only speed at impact, but how much power each engine was developing, and what steps the pilot had taken at the time of the crash.

Fire aloft? It is seldom difficult to distinguish between fire in flight and that resulting from a crash. A substantial fire aloft almost always leaves deposits back along the flight path. Driblets of metal are analysed: If they are magnesium, they probably came from an engine's accessory section; if they are dural, they are probably from airframe or skin. Even a single popped rivet can tell a story, because different kinds of rivets are used in different parts of a plane. Impact fire can be distinguished by ground blackening and other characteristic patterns.

Reading metal. The story of most plane crashes is pieced together from scraps of plane that are collected and studied with the patience of Job.

Microscopic or X-ray analysis of a part that has failed will often reveal a clue. "Cross-graining" at or near a failure, particularly in a forging, suggests a fatigue cause. Manufacturing flaws—tool marks or even scratches —may show up in meticulous examination. Micrometer measurements of bolt lengths, and study of thread distortion, may point to a faulty torque wrench—or mechanic. Analysis can often even introduce a time factor. Metals rubbing together can develop a high polish; microscopic examination of the depth of scratches in this bright spot can tell how long the rubbing went on.

Such is the nature of the "horse sense" used in determining crash causes.

Though these men flinch at the nam "crash detective," they use many of th techniques of crime detectives. A scratch on a wing panel, a wisp of cha red fabric, even the odour of a fragmen of wreckage can be a vital clue.

This was one of the easier ones. Th right engine had burned free and drop ped off in the air. Farther back alon the flight path was the engine's No. 1 cylinder, broken off just above its bolt down flange. It was obvious that fue fed to the broken cylinder had blaze aft past the engine accessories.

CYLINDER RUPTURE

But what had caused the cylinder t rupture? That question led back to th airline's maintenance base. Record showed that the same cylinder had bee pulled from another engine when eigh of its 15 hold-down studs had failed A mechanic had neglected to inspect it hold-down flange for warping—ignorin strict rules in the overhaul manual. Th warping produced extra strain on th cylinder walls when the flange was snug ged down; and the strain led to a frac ture that sent 30 persons to their deaths

In another crash case, a DC-3 los an engine minutes after take-off from New York's La Guardia Airport and crashed into the bay. All five person aboard were killed. It looked at firs like a case of faulty airmanship.

THESE DIDN'T BEAT THE EXPERTS

FAMILIAR SIGHT IN CRASH-RECONSTRUCTION is the simulation of cabin seating, using the remnants of chairs from the wreckage. This is the aft cabin of the plane that exploded near Longmont. In the foreground are seats that were just above the dynamite bomb — torn apart by the blast. Another piece of conclusive evidence was a stewardess' waste container that had been collapsed inward at the bottom. The investigators, determining that the container could not have been battered that way by ground impact, knew the violence had occurred aloft.

Then the medical examiner made an lectrifying discovery: Post-mortems in- icated considerable alcohol in several f the bodies. Immediately the district ttorney and a grand jury got into the ct: If drunken pilots were flying over own, something should be done.

Meantime the C.A.B. was quietly and ethodically following its own inquiry. When the wreckage was raised from the ay, two tanks of de-icing alcohol be- ind the pilots' seat were ruptured.

At the customary hearing a Yale phy- iology professor testified that he had rowned rats in water having about the ame concentration of alcohol that had een in the submerged cockpit. The ats' livers showed five times the per- entage of alcohol found in that of the lane captain. The C.A.B.'s terse ver- ict: "Insufficient airspeed for single- ngine operation."

DEADLY CARGOES

Then there was the time a perplexing xplosion staggered a transport over alifornia. The captain, leaving the con- ols to his co-pilot, found a huge hole lown in the fuselage. The plane flew n steadily, and landed safely at the next rfield.

A head count showed one passenger issing. C.A.B. investigators found his ody back along the flight path, the fin- ers of his left hand mutilated.

THE VILLAIN: Taking a hard look at the placement of the DC-6's belly scoop . . which feeds air to the gas-fired cabin heater and air-conditioning system — investigators made some tests. Aloft, they pumped coloured water, simulating gasoline, through a wing hole in line with the plane's gasoline-overflow vent. When the airstream carried the stain to the scoop, crash detectives knew they had the answer to the Bryce Canyon and Gallup fires: In levelling their tanks, the planes' captains had unwittingly dumped gas into their own gas-burning heaters.

Painstaking analysis of fragments ound near the hole in the fuselage led the deadpan C.A.B. verdict: ". . . robable cause . . . was the act of a assenger exploding dynamite."

That was suicide. When a DC-6 rangely disintegrated in flight, killing 4 persons, the investigators had a case f mass murder on their hands. Careful udy of the fragments indicated an ex- osion in a baggage compartment. A an named John G. Graham confessed at he had put a clock-actuated dyna- ite bomb in his mother's luggage, and ad insured her heavily.

The crash of the chartered twin-engine ane that killed Mike Todd, then hus- band of actress Elizabeth Taylor, was solved in hours. The pilot's manifest and fuelling record showed that the plane was overloaded at take-off by a ton. Icing had increased the load.

Investigators found the right prop feathered. Inside its engine was mute evidence that the master rod bearing had failed in flight. The remaining engine couldn't sustain the overloaded, iced-up plane.

Perhaps the most exhaustive investigation happened years ago, when the DC-6 was new.

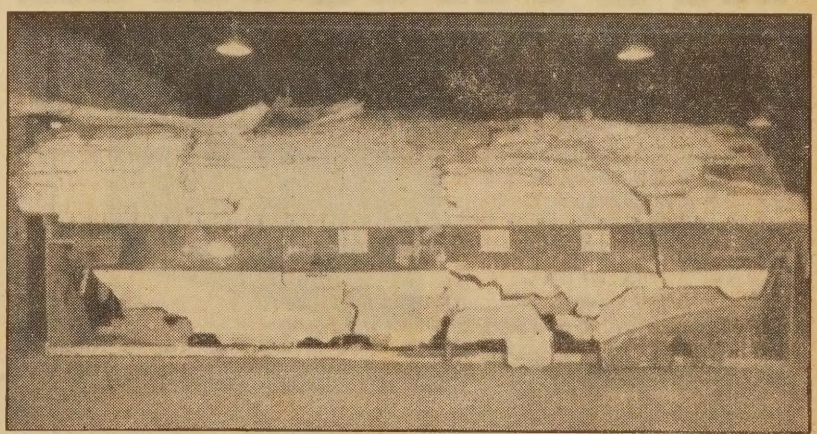
On October 24, 1947, United flight 608, bound for Chicago, left its runway at Los Angeles at 9.35 a.m. Captain Everett L. McMillan had eight separate fuel tanks in the wings of his plane, four main ones and four alternates, containing in all 3,350 gallons of high octane. No. 3 alternate had 302 gallons, 229 below its capacity. No. 4 alternate had 480.

FIRE ABOARD

McMillan had a substitute for his regular co-pilot this day. In the cabin were 47 passengers, two of them infants and three stewardesses.

The flight made its routine position reports. Then, at 12.21 mountain time, one hour and 46 minutes after take-off, came this message: "United 608. We have a baggage fire aboard. We are going in to Bryce Canyon [Airport]. We have a smoke-filled airplane . . ."

At 12.26, this: "Tail is going out. We may get down and we may not."



PROBING FOR THE CAUSE of a crash near Longmont, Col., in which 44 persons died, investigators patiently searched for pieces of the airliner over a wide area where it had exploded in flight. Then they built a wood framework, covered it with chicken wire and fitted pieces of the skin on it, with the above result. Near the rear baggage compartment they ran out of pieces—the disintegration had been complete. But they knew the plane normally carried nothing combustible in that area. Result: The disaster was traced to a dynamite bomb.

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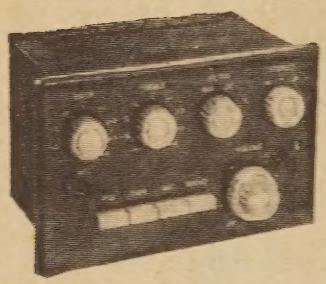

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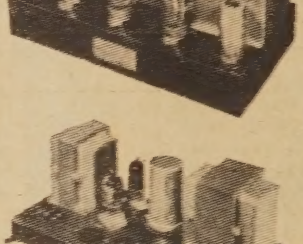

R D CADET AMPLIFIERS

Two Cadet Amplifiers, again connected with the Stereo Control Unit, provide the ideal basis for the average Hi-Fi Stereo System. Peak output: 6 Watts. Inter-mod. distortion: 3·5% at 4 Watts. Hum and Noise: -72 DB below 5 Watts. Price, **£29.12.6 each.**

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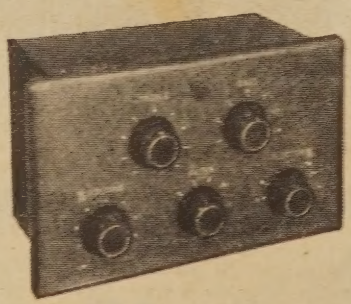

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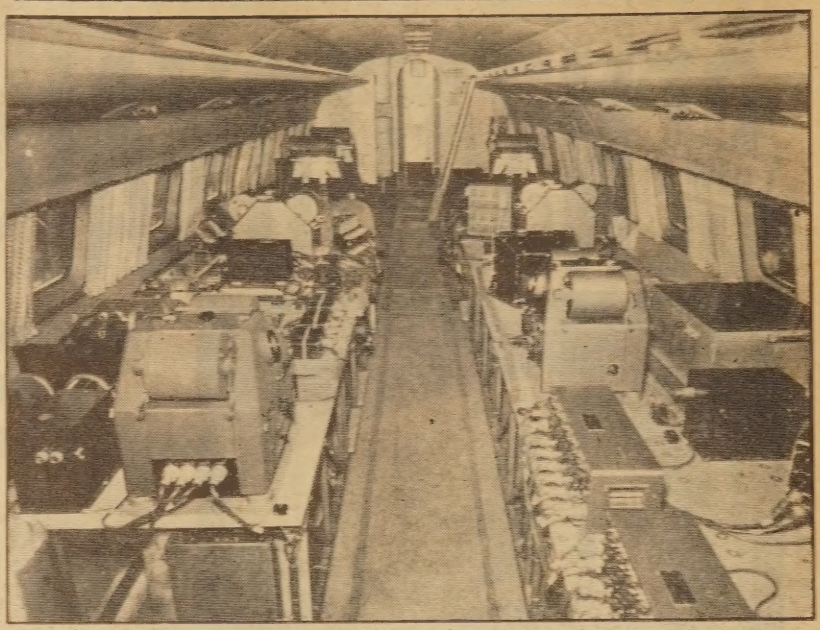
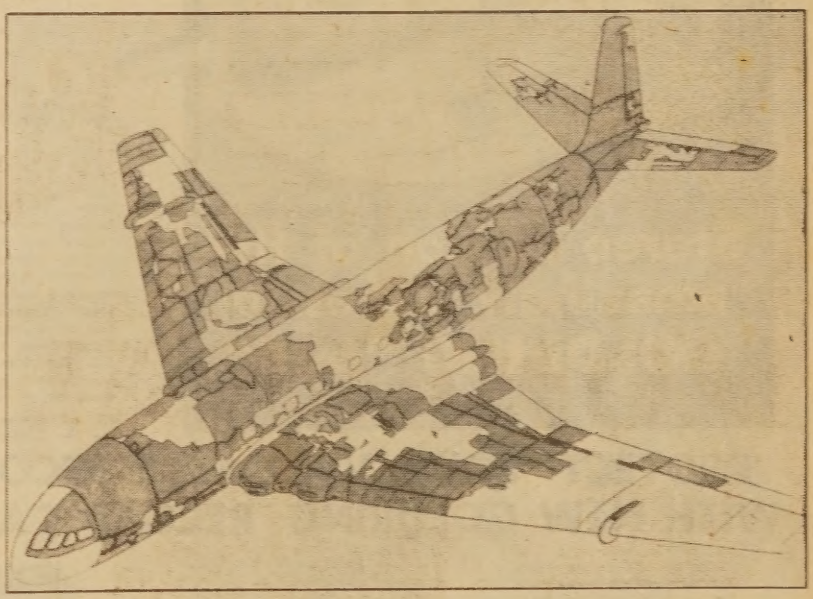


Packed with instruments, this early model Comet, sister ship to those which crashed in the Mediterranean, was given the most thorough testing ever to a civil aircraft.



Fished out of the sea off Elba, the shaded parts were reassembled on a wooden mockup. These and other observations pin-pointed a failure in a particular point of the fuselage due to metal fatigue.

At 12.27: "United 608 sending blind . . ." A pause ensued, with unintelligible background conversation. "May take it—think we have a chance now -approaching a strip."

A minute later the airplane crashed. illing all aboard.

Aided as usual by technicians from e airline and the plane manufacturer, .A.B. men combed the ground on the ght path, afoot and on horseback, for) miles. The search yielded a flotsam tragedy—a baby's nursing bottle, a allet, a grocery list. It also yielded arium nitrate ashes.

The only known barium in the plane ad been in emergency-landing flares rried in the right wing "filleting"—e streamlined strip where wing met selage. Had the flares ignited and used the fire, or had the fire ignited e flares? C.A.B. ordered all flares reoved from DC-6's.

OT BARIUM

In its race to self-destruction, the ane had shed bits of skin and control rfaces, and these contained traces of el residue, not barium. Each of these as collected, identified, and affixed to icken wire stretched over a wood fusege mockup.

Meticulous study of the result indited that the fire had begun near the oiler room," a space in the ship's lly that housed a gasoline-fired heater r warming the cabin and cockpit.

The boiler room was about at the ntre of the rear spar, one of the two g transverse beams in the wing. Below it, out in the airstream, was an airoop to feed the heater. Behind that was baggage compartment. Study showed at the fire had swept for 20 feet along e lower right side of the fuselage, and en surged up and over the top of the bin.

Each fuel tank had a vent. The vent No. 3 alternate contained fine traces green stain, colour of the high-test as aboard. No. 3's vent, inboard and st below the leading edge of the right ing, looked dangerously placed—practically in line with the heater scoop.

That had to be it. But C.A.B. investigators have to prove their suspions.

CLUE

At this point they got an unexpected sist. On November 11, at Gallup, M., an identical transport had a similr fire but—perhaps because flares were moved—managed to get down without suralties. The significant fact: A few oments before, the captain had been velling the fuel in his tanks.

When Captain McMillan's regular coilot, who, of course, knew his colague's habits, took the witness stand, e mystery was about solved.

It was the captain's practice, he said, take off on his main tanks and, after hour or so, switch to his alternates. hen, after a period of time, he would evel the alternates by pumping fuel om one to another through crosseds.

With variations, this practice was ommon among DC-6 captains. Another witness, a DC-6 pilot, was asked, Can you tell in flight whether a tank full or not?"

"No," he answered.

That did it. C.A.B. and Douglas technicians painted a DC-6's belly with scouring powder, to retain a stain. Then they put aboard a drum of red-dyed water, to simulate gas. Aloft, they pumped the water through a hole in line with No. 3 alternate's vent. The airflow carried the stains directly into the heater airscoop.

FUEL FOR FLAME

There remained only the inevitable hypothesis. Levelling his tanks, Captain McMillan had begun cross-feeding from No. 4 to No. 3. No. 3 filled but the electric pump was not shut off, and the tank overflowed.

The plane had declared an emergency seven minutes before the crash. Allowing a minute for the discovery of the fire, the tank could have overflowed for eight minutes. During that period as much as a hundred gallons of high octane could have poured into the heater airscoop.

The heater quickly ignited the fuel. Flames sheathed the fuselage. At least one flare ignited. Fuel lines ruptured. Control cables burned through—"Tail is going out . . ." And the crew, seeing the fire-warning light from the baggage compartment just behind, misread the cause of the fire.

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SPACE-TO-EARTH RADIO SIGNALS

By W. Vesper, Dipl. Ing., Telefunken–Ulm

While it is problem enough to launch satellites into space, it is also very difficult to get back the information they have to give. In this sense, according to the writer of the following article, rocket engineering is outstripping radio.

SPACE-TO-EARTH radio signals are those signals transmitted to earth from rockets launched into space. Some circle the earth as satellites for a certain period, whilst others fly off into space too far for the radio signals to be received by stations on the earth.

One of the chief problems in connection with the space-to-earth transmission is the range of the radio transmitters carried by the rockets. And here it must be admitted that radio techniques are behind the present stage of rocket engineering.

WAVES SPAN EARTH

This may seem strange to the layman because, for quite some time, we have been accustomed to using transmitters which span the earth and whose waves, much to the regret of communication engineers, even travel several times around the earth!

The maximum distance of our artificial earth-satellites from the earth ranges from 2,000 to 4,000 km.

However, it must be remembered that ground transmitters, which can cover such ranges, are very extensive and weighty installations.

Furthermore, each gram payload in a rocket requires many times its weight in propellent charges in order to carry the rocket out of the gravitational field of the earth. Every effort must therefore be made to minimise the dimensions of a space-rocket transmitter and, at the same time, to render its operation as reliable as possible.

A further and major point of difference exists in the antenna system. For normal communication over great distances, the expenditure required for transmitter and antenna is divided into about equal proportions.

LARGE ANTENNAS

By means of special antenna arrays, the transmitter energy is radiated only in the desired direction. Such directional antennas have large dimensions and, therefore, cannot be considered for rockets. Consequently, "gain" in terms of the radiated energy is not possible on the transmitter side.

A motor-car headlight provides a useful analogy. If the parabolic reflector of a headlight were removed, the range of sight would be severely limited, since only a small proportional of the total light would be effective in illuminating the forward path.

A third restriction on the satellite transmitter is the available power supply, which is often more of a limitation than the actual size of the transmitter components.

For transmitters on the earth, the energy for the power can be provided by the uninterrupted supply of hydraulic power, coal or oil. However, in a rocket, source energy can be stored only in limited quantities.

Although silver-zinc or mercury batteries are used which, with minimum weight, produce a maximum amount of current or a certain current intensity over a maximum period, this storage capacity is limited. Again, while solar radiation can provide a source of energy of unlimited duration, solar batteries of sufficient power are, as yet, quite bulky.

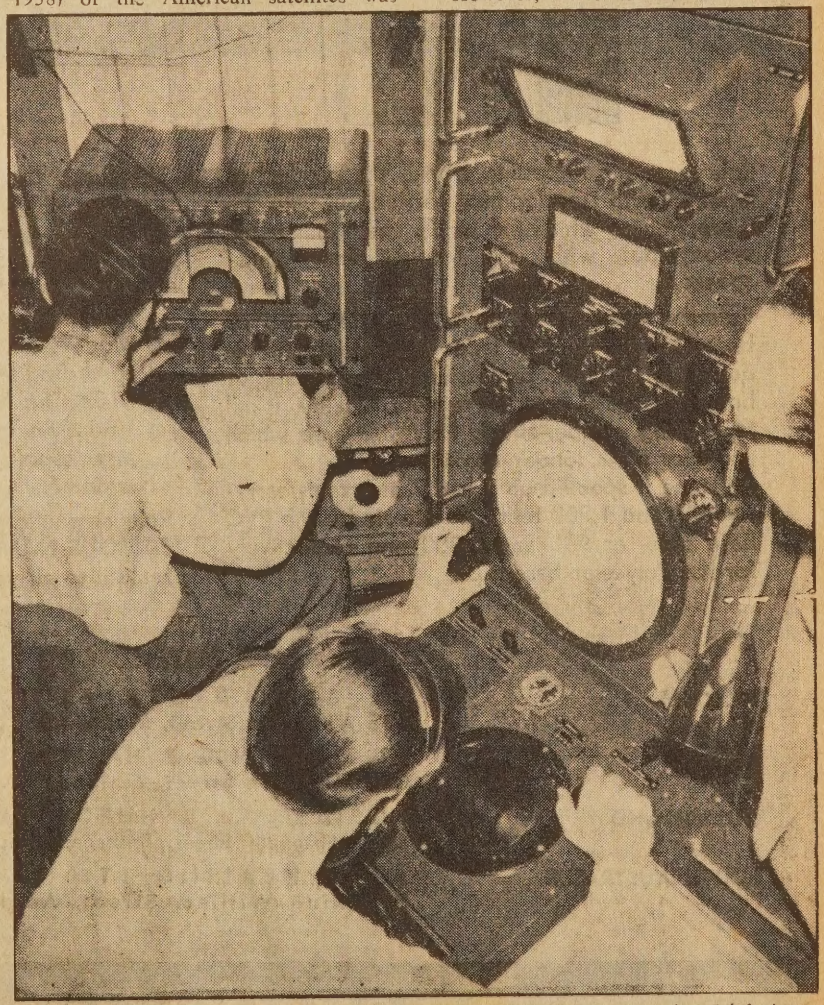
Solar batteries operate according to the principle that silicon or selenium cells deliver current when activated by light. One of the best known applications is probably the electric exposure meter.

Up to now, only the "1958 Beta" (Vanguard I, launched on March 17, 1958) of the American satellites was equipped with a silicon solar battery for the 5-mw transmitter. The second, more powerful, transmitter was fed by a mercury battery.

Considering these restrictive conditions, the transmitter power and frequency must be so selected that the field strength produced on the earth's surface by the rocket transmitter is usefully above the field strength of ambient noise and interference.

The noise level which originates from all possible discharge phenomena in the atmosphere and from interstellar space decreases at shorter wave-lengths. The components, also equipment as well as antennas, become smaller.

However, there is the disadvantage



Signals transmitted by an earth satellite are being received here by Telefunken instantaneous reading direction finder, installed on the company's testing ground. The signals are also photographed and recorded on magnetic tape.

Here NOW!

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"The Tape with the Famous Name"

Rola magnetic recording tape is the product of Research and Development carried out with the thoroughness which has made the Rola name synonymous with the world's finest loudspeakers.

Rolatape comes in two grades — 1½ mil PVC base General Purpose tape which meets the requirements of most professional, educational, or home recordists and a Premium Quality 1 mil tape using a super-strong Polyester base which provides 50% longer recording time.

Rolatape is spooled on 5 and 7 inch reels carrying 600 and 1,200 feet respectively for the PVC base tape, or 900 and 1,800 feet respectively for the Polyester base tape.

These are the internationally recognised standards to which Rolatape is made:

- ***Frequency response beyond 15,000 c.p.s., at a speed of 7½ inches per second.***
- ***Background noise more than 65 db below recording level.***
- ***Modulation noise more than 50 db below recording level.***
- ***Distortion less than 2%***
- ***Variation in output less than 1 db over any spool and less than 2 db between spools.***

Rola magnetic tape — **"THE TAPE WITH THE FAMOUS NAME"** — will bring new depth and realism to all your recordings.

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RECORDING SATELLITE SIGNALS

very short waves are propagated much the same way as light rays and transmitter can be heard only as long t can be "seen" on its path around earth beyond the horizon.

y international agreement, the frencies of 108.0 and 108.03 Mc have n set aside for satellite transmitters. se frequencies are slightly above our F broadcasting band.

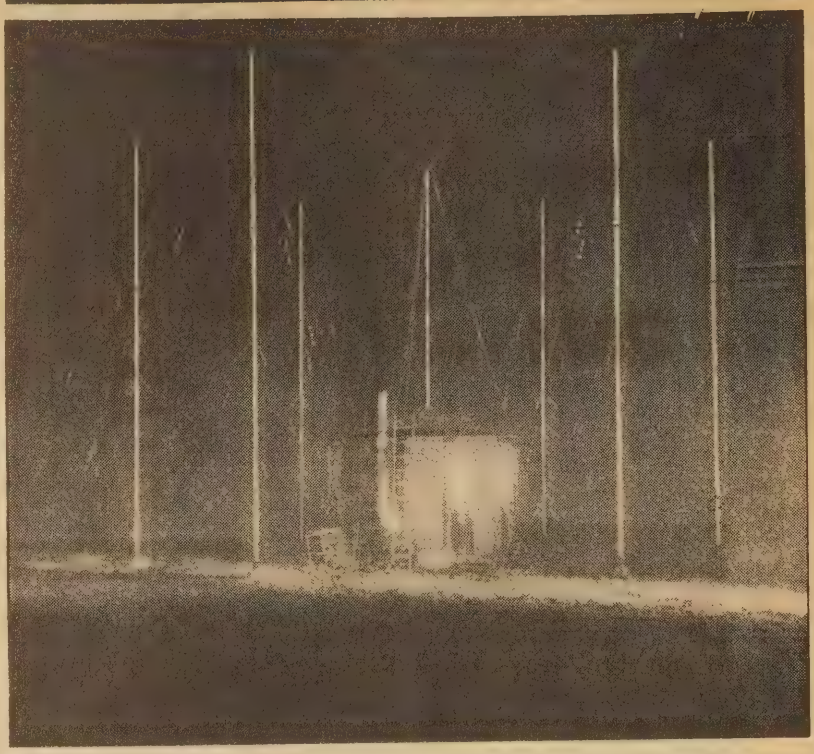
On the other hand, the Soviet Union rates its satellite transmitters on frencies in the upper shortwave range, nely on 20 and 40 Mc. Possibly, wish of the Soviets to depend for r observations as little as possible on er sources of information was decisive selecting both these frequencies.

GHER POWER

Although the required power is higher, ervations can be made "below the izon." This is due to the fact that electromagnetic waves are conducted, in a waveguide, in a reflecting layer eaviside layer) which surrounds the th. The waves of the satellite transter penetrate at sufficiently steep gles into this "waveguide."

Fortunately, it is possible to compene to some extent in the receivers for at can not be provided in the transters, due to the restrictive conditions. is involves using the most sensitive revers and "focusing" on the received rgy. Interference from other direcns is thus minimised and the signalnoise ratio improved.

Sharply focusing antennas must be ected on the transmitter and, during reception, must follow the position the transmitter. At shorter waves, the using is easier, because the antennas smaller.



The D.F. cabin with Adcock antenna on the Telefunken testing ground near Ulm. The instantaneous reading direction finder for taking bearings on the satellites was housed in this cabin.

A close-up of the receiver-recorder show on previous page. A camera, mounted over the slot in the centre of the picture, records the bearing indication on the C.R.O. tube, together with the time, as indicated on the clock face alongside.

The nature of the intelligence which the satellite's radio equipment beams back to earth will not be discussed here in detail. The instruments contained in the satellite measure temperature, cosmic radiation, size and number of the meteorites flying through space, the magnetic field of the earth.

These measurements can be transmitted in different ways, namely, by amplitude modulation, phase modulation, pulse-length or pulse-phase modulations. Their reception requires a sufficient signal-to-noise ratio.

STILL OBTAIN DATA

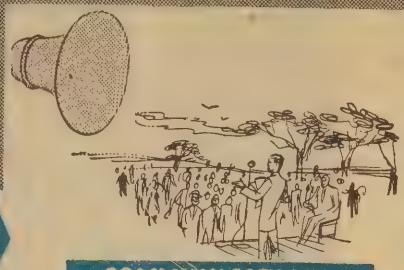
Even where this condition is not fulfilled, it is possible to obtain valuable data by determining the propagation direction of the incident waves according to their fluctuating strength (fading) and direction (bearing) as well as by observing the change in the frequency (Doppler shift effect).

Evaluation of all these data can provide the physicist with important information about the nature of the earth's surroundings.

For example, the first American satellite "1958 Alpha" was received by Telefunken engineers by means of a series-produced commercial VHF receiver, Type E 149, and an antenna that did not exceed the cost of a medium-sized television antenna.

During the observation of the Soviet satellites "Sputnik I" and "Sputnik II," the Instantaneous Reading Direction Finder of Telefunken supplied an abundance of data whose evaluation by the Max Planck Institute in Weissenau, near Ravensburg, has already brought forth valuable results.

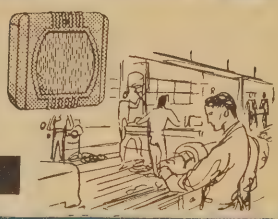
FOREMOST IN SOUND . . .



COMMUNICATION

ENTERTAINING

PAGING



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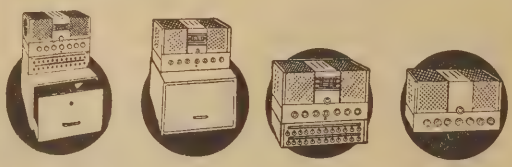

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Energy Unlimited!

By KENYON KILBON

The C Stellarator Project is expected to play a key role in harnessing the fusion process, thus releasing the energy locked in sea water for the benefit of mankind.

FINDING the combination that will free this virtually infinite energy for the benefit of humanity has today become a major goal of scientific research in the United States, in Great Britain, in Russia, and in other nations of the world.

The answer lies in the control of thermonuclear fusion—the process that goes on continuously in the sun and the stars. Man already has succeeded in recreating the process on earth, but only in the furious, uncontrolled blast of the hydrogen-bomb.

The fuel for the process—deuterium, or heavy hydrogen—is plentiful and easily obtained.

The amount of deuterium in only one gallon of water, if it were completely fused, could supply the average household with all of its electrical energy for a year or more.

The problem now is to achieve the means of control, so that the fusion process, once started, can be held tightly and continuously within bounds to supply endless power for the homes and factories of the world.

By any standards, it is an imposing problem. And an imposing array of scientific and engineering talents have been brought to bear upon it.

PROJECT SHERWOOD

In the United States, the principal effort is being directed by the Atomic Energy Commission through a group of related research programs under the name of Sherwood Project. RCA scientists and engineers are playing a vital part in a most promising phase of this effort, now under way at Princeton University.

The Princeton program is based upon a concept of Dr Lyman Spitzer, jun., chairman of the University's Department of Astronomy and director since 1951 of Project Matterhorn, the name given to Princeton's part in the over-all Sherwood Project.

To carry on this program, the University and the AEC have selected RCA and the Allis-Chalmers Manufacturing Company to design and build a great new fusion research facility known as the Model C Stellarator — a name coined from "stellar" and "generator."

The C Stellarator facility, to be completed in 1960, will be comparable in cost and complexity to some of the largest "atom smashing" particle accelerators now in existence.

It is designed not as an operating reactor but as a flexible research facility for a variety of research programs in the controlled thermonuclear field.

The two companies have assigned many of their outstanding scientists and engineers to an unusual engineering staff organisation known as C Stellarator Associates. Today, this staff is at work at the University's James Forrestal Research Centre, two miles from the Princeton Campus, meeting and overcoming unprecedented problems of electronics and electrical engineering.

SIMPLE IN PRINCIPLE

In principle, the fusion process is quite simple. The snag arises in translating principle into practice.

Basically, fusion is comparable to ordinary chemical combustion, in which the combination of burning molecules releases energy in the form of heat that may be put to various uses.

Ordinary combustion requires a means of ignition (a match, for example), a fuel (such as coal or oil), and, if the heat is to be used, a combustion chamber (such as a stove).

The fusion process involves this same sequence of events, but with a staggering difference in the conditions that must be met.

In fusion, the means of ignition—the "match"—must somehow produce a temperature of 100 million degrees centigrade or higher. The fuel must consist of light atomic nuclei capable of combining into heavier nuclei and releasing considerable energy in the process.

The "stove" to contain these happenings must be capable of withstanding the 100-million-degree heat — a requirement somewhat complicated by the fact that there is no known material that will remain solid above 3,000 degrees centigrade.

The solution as conceived for an operating fusion reactor is to raise the initial supply of deuterium fuel to extremely high temperature by ohmic heating, comparable (but on a vast scale) to the action that takes place in an ordinary toaster. The result is a hot gas composed of free electrons and ions—atoms from which electrons have been torn.

MAGNETIC "PUMPING"

The hot gas, known as plasma, is in turn raised to the required thermonuclear temperatures by magnetic pumping, causing the particles to move at such enormous speeds that they will collide and fuse to produce the desired release of energy.

Once the process has been started by ignition, it would continue as long as it had fuel on which to feed.

Somehow, this process has to be contained by a force that will hold the plasma together so that the collisions will continue to occur. Since there is no known material that can be used as a "stove" for this purpose, the scientists have turned to matterless "walls" consisting of extremely strong magnetic fields, up to 100,000 times more intense than the magnetic field of the earth itself.

In the Stellarator, this magnetic "container" will be created by external currents within a closed endless tube having the shape of either a figure 8 or a racetrack.

The awesome physical plant that will comprise the C Stellarator and its associated electronic and electrical equipment already is beginning to take shape.

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  Ensures constant speed throughout battery life.
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  Battery drain—approx. 45 milliamps.
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  Light and compact—makes it ideal for transistor powered portables.
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PRINCESS OF TASMANIA IS PACKED WITH RADIO

Though much has been written about the new passenger-car ferry Princess of Tasmania, little has been said about the very large amount of electronic gear which it carries.

LIKE the rest of the ship, most of the radio gear has been designed and built in Australia—actually by Amalgamated Wireless (A'sia) Ltd. The rest has come mainly from the Marconi Company in England.

In actual fact, the "Princess" carries just about every modern device known to navigation. Some of it, indeed, will probably never be used outside of periodic "emergency" testing. One such unit is the direction finder.

This instrument is on the bridge and, in the event of ordinary navigation instruments failing, it can be used to take a bearing from other ships, or from shore radio beacons.

RADIO-TELEPHONE

The "Princess" is one of the few ships on the Australian coast fitted with a radio telephone. A VHF-HF installation, it operates like any other phone, except that the captain doesn't dial his number; he switches on and calls his contact by radio. He can "phone" other ships at sea, or port authorities on land. It can be used to give and receive weather reports, progress of the voyage, or any other message which may be necessary.

On the bridge, too, is an Echo Sounder, an electronic device which can tell the captain at any time how much water is under his keel. This machine can register ocean depths to 720 fathoms, or 4,320ft.

The radio room is packed with electronic gear. The main transmitter is a Marconi "Ocean Span." It is primarily a combination long- and short-wave unit, but it also incorporates a radio telephone. Passengers may use this phone to keep in touch with business associates or friends ashore.

Supplementing this is an emergency transmitter which operates on batteries should the power supply to the Ocean Span fail. Incoming signals are picked up by an Argosy receiver and for this, too, there is an emergency unit, also battery-operated, called the "Seavigil."

AUTOMATIC ALARM

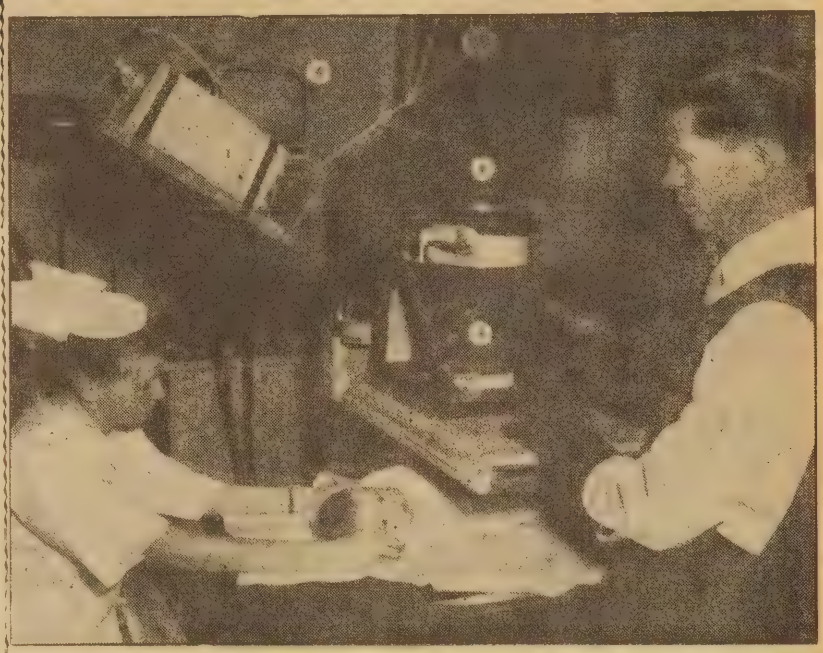
The Princess of Tasmania, being on a one-night run, carries only one radio officer. Naturally, he cannot be on duty 24 hours a day. But his electronic equipment is. When he goes off duty he sets an automatic alarm receiver, and should a ship in distress send out a call for help a bell will recall him and appropriate action can be taken.

Similarly, should an emergency arise on his own ship and he has to leave his post to attend to equipment elsewhere, he can set his auto key to go on relaying a distress call until he returns.

And should the worst come to the worst, and the ship's complement have to take to the boats, the radio operator

(Continued on Page 25)

TV X-RAY COMBATS RADIATION



Dr. Hiller conducting an X-ray examination with the new TV equipment. The camera (1) scans the viewing screen of an electron accelerator "periscope" (2), which is mounted on the electron accelerator itself (3). A monitor screen (4), attached to the wall of the Theatre, enables the Theatre staff to view the examination while it is taking place.

A REVOLUTIONARY X-ray screening unit, which substantially reduces radiation dosage by means of a closed-circuit television system, has been installed by the Radiology Department of the Royal Children's Hospital in Melbourne.

The unit, which is the first of its kind in Australia, will enable doctors to make permanent motion picture records of important examinations and will greatly simplify teaching by permitting telecasts of actual X-ray screenings to be made to any part of the hospital.

Installation of the equipment resulted from a long series of experiments conducted by the hospital's Department of Radiology. In conjunction with a Melbourne engineer, Mr Alan Gibbs, who represents the makers of the TV system, Pye Limited of Cambridge, the radiology department evolved a working unit which is substantially cheaper than equivalent systems used abroad.

RECENT DEMONSTRATION

The complete system was demonstrated recently to a group of leading Melbourne physicians, surgeons and radiologists. Through a 14in monitor screen in the hospital's lecture theatre, the group watched an examination taking place 300 yards away in the radiology theatre of a child with a suspected stomach obstruction. The entire examination was also recorded by a movie camera which scanned a monitor screen.

The head of the hospital's radiology department, Dr H. G. Hiller, said that the use of TV in radiology had an enormous potential.

"One exciting application that I can foresee is in the Flying Doctor Service," said Dr Hiller. "It is not beyond the bounds of possibility that in areas remote from a base hospital an X-ray-TV centre could be operated by a semi-skilled person.

"For instance, in the case of a suspected fracture of the bone, a picture could be telecast to the Flying Doctor base for expert diagnosis, which in the long run would prove cheaper than flying the patient to the base for examination."

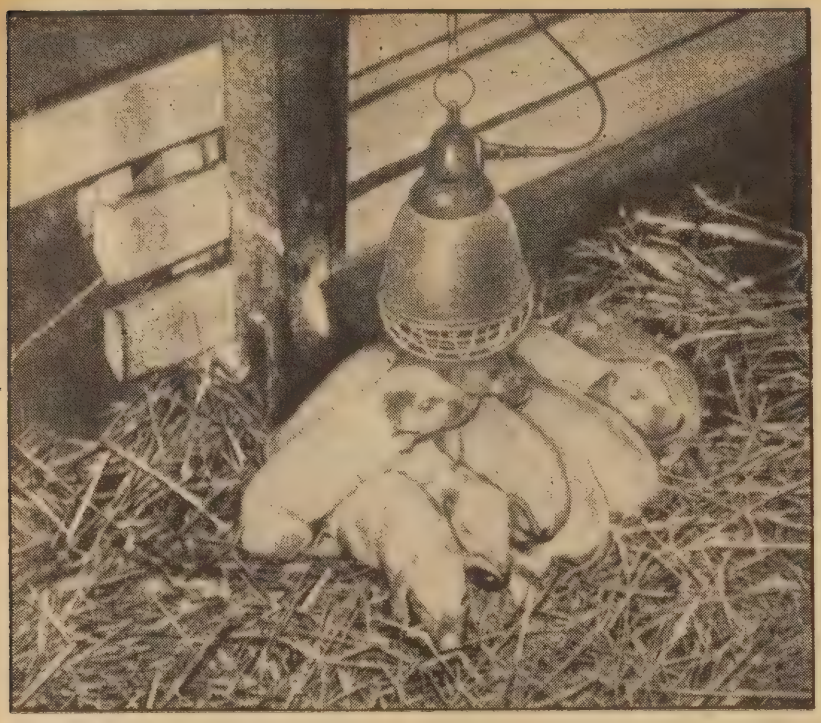
MOTION PICTURES

Dr Hiller added that the use of motion picture records was assuming increasing importance in radiology. He said that while "still" pictures of an X-ray were perfectly satisfactory in static conditions, such as a bone fracture or a fixed growth, this was not so in other fields of investigation.

"For instance," he said, "there is the case of dye injections, where it is necessary to observe the rapid passage of dye through the heart and the blood vessels in the brain or kidneys.

"In these cases, much depends upon the observations made by the radiologist or physician while the examination is taking place. Even the most carefully recorded notes and still pictures depend upon the memory of the doctor carrying out the investigation for complete interpretation.

"If, as sometimes happens, he is asked for an opinion six months later, how much can he trust his memory of something that was glimpsed only fleetingly? With a movie record of the examination, all that doubt is eliminated."



As a source of warmth, the infra-red lamp may not seem quite as homely as mother pig, but it is far safer. It doesn't turn over in the night and suffocate them! (Photo by courtesy of Philips Electrical industries.)

A Host Of New Jobs For Infra-Red Rays

Many people think of infra-red as something which is supposed, mysteriously, to cure an aching joint or muscle. In point of fact, the term is involved in a great many aspects of science and research.

by Calvin Walters

TO be sure, many infra-red devices have been made and sold under the guise of a medical appliance. Some are good. Some are nothing more than an electric element similar to those used in a radiator. Such do little more than radiate heat as distinct from infra-red radiation.

Results just as effective can be obtained by the application of a hot brick or the mother-in-law's hot breath.

Whilst the principles behind the propagation of electromagnetic waves have often been described, it is necessary to give a short refresher course in order that this subject of infra-red will be adequately understood.

All the molecules which go to make up matter, as we know it, are in a constant state of motion, which increases with increase of temperature and decreases with decrease in temperature.

The lowest temperature possible is minus 273 degrees centigrade. At this temperature all molecular motion ceases.

We know that molecules consist of electrical charges and that, as the temperature is raised, the increasing movement or oscillations of these electrical charges causes the substance to radiate energy which is transmitted into space in the form of waves. This is called electromagnetic energy.

It is the temperature and size of the radiant body which, for our purposes, governs the intensity and the wavelength of the vibrations which are emitted.

The energy which is radiated into space is called radiant energy and travels with the speed of light, namely 186 thousand miles per second. Different kinds of energy have different wavelengths.

The scale of the various wave-length is called a spectrum. At one end of this spectrum are the shortest wavelengths which are of the order of one hundred thousand millionth part of a centimetre long.

From this inivisible part of the spectrum we progress through visible light to the other end, where the waves are about 5,700 miles in length!

What is called the visible spectrum is the range of wave-lengths which is visible to the naked eye. When passed through a glass prism this visible light is separated into its various wavelength sections and is projected in the form of a band of colours exactly the same as a rainbow. These colours range from the longest visible wave-length red to the shortest, violet.

SHORTER WAVELENGTH

Beyond the violet rays there is a gradual diminution of the wavelength producing in succession ultra-violet rays, soft X-rays, hard X-rays, gamma rays and finally the shortest rays of all, cosmic rays.

Going the other way from the red rays, there is a progressive increase of wavelength.

These give us in order, short-wave infra-red, long-wave infra-red and on to radar and radio waves.

It was Sir William Herschel in the year 1800 who first discovered that heating rays existed beyond the visible red end of the spectrum. He passed a blackened thermometer bulb in the region beyond the visible red and noticed that there was actually a greater heating effect in this region than anywhere else in the coloured band of the spectrum. The rays responsible were called infra-red.

However, this gentleman didn't do anything about it. Neither did anyone else, for that matter, until over a hundred years later.

From 1920 onwards, many applications of infra-red have been devised.

The most widely known application of infra-red is the taking of photographs in darkness. This was developed years ago and was made possible by the recognition that all bodies emit the form of "heat" waves known as infra-red rays. It then only required the development of suitable lenses and photographic emulsions which were sensitive to these rays, in all their varying intensities, to make infra-red photography a practical proposition.

If the body is of irregular formation

either in density or contour, the powe of the rays emitted will vary accord ingly. The effect is similar to the emis sion or reflection of light. If the body consists of flesh, clothing, spectacles, hair and so on, the emission or reflec tion of light will vary and so affect a photographic plate accordingly.

So it is that these things also emit varying intensities of heat radiation, which will affect a plate in a similar way.

The word "heat" has been used here, but this is not altogether accurate. Whilst infra-red radiation is connected with heat it is fundamentally different to heat waves for the reason that it is an electro magnetic vibration, similar to radio waves, except in the matter of wave length.

THROUGH VACUUM

It can, therefore, be transmitted through a vacuum, whilst other forms of heat cannot. They must have air for their transmission by conduction or con vection.

The intensity of an infra-red wave at a given wavelength varies according to the temperature of the emitting body. Thus, it is possible with a small tung sten filament to have a very high inten sity, because the filament can be heated to a very high temperature.

This property is made use of in the now well known infra-red lamps, which have a small intensely hot filament en closed in a bulb with a special internal reflector.

By regulating the temperature it is possible to adapt the radiator as closely as possible to the particular purpose de sired.

The transmission of infra-red radia ion follows a law which is universal for all electromagnetic radiation. This law states that the intensity of the energy radiated by a body varies inversely as the square of the distance from the body

In simple language this means that the energy at two miles from the emit ing body will be only a quarter of the energy which would be present at one mile from the body.

QUARTER OF ENERGY

This is an important property which is made use of in some applications of infra-red radiation, especially where infra-red is used in upper atmosphere and space exploration.

Infra-red rays are subject to reduction in intensity when passing through the atmosphere. This is brought about by absorption of the rays by carbon di oxide, water vapour and dust particles.

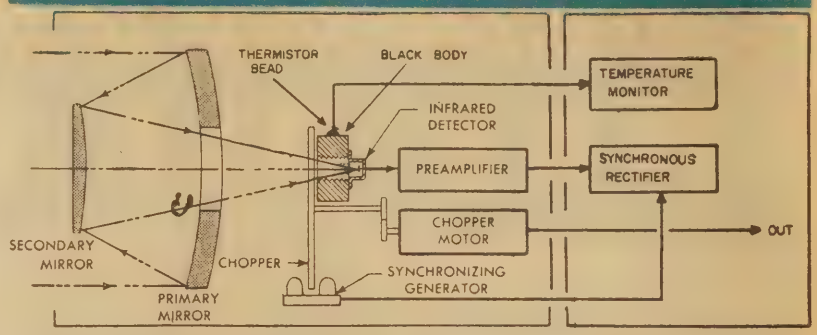
A peculiar property is that the absorp on of rays is not uniform but takes place at wavelengths which resonate with the molecules of the atmospheric gases. At wavelengths where this reson ant effect is at a minimum it is possible with suitable apparatus using filters to transmit infra-red rays over much great er distances.

Once these regions have been traversed and penetrated by the rays, they suffer little attenuation beyond 100,000 feet and none at all in outer space beyond this, because there is no atmosphere.

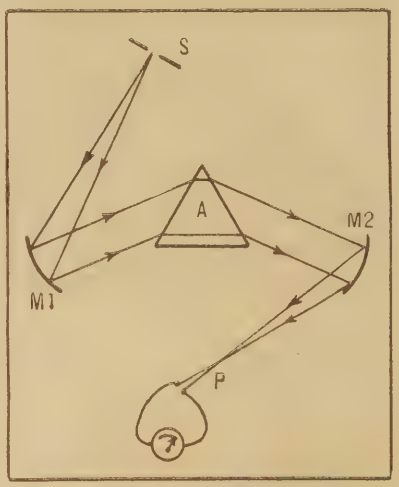
In the areas of space used by rockets and satellites, therefore, the peculiar properties of infra-red can be utilised with instruments mounted in missiles or satellites.

Perhaps the most recent and outstand ing use of infra-red rays is the tracking of satellites and missiles during the early stages of flight from take-off

BASIC INFRA-RED RADIOMETER



In the radiometer, illustrated above, infra-red rays from a distant object are compared with those from an internal standard source, the relative intensities being presented as a chart.



In the infra-red spectrometers, rays rich in infra-red are passed through slit "S" on to mirror 1, thence through the prism "A" to mirror 2 and to the thermometering circuit P. Rotating "A" selects operative wavelengths, while samples are placed between the source and slit "S"

During World War II various instruments were devised for locating prospective targets but the latter needed to be illuminated in some way for location by the infra-red tracker.

Tracking of missiles can be accomplished at close ranges more accurately than with radar. More detail is possible because of the fact that infra-red rays are up to a thousand times shorter than radar waves.

An outstanding example has shown that a radar apparatus with an antenna 12 inches in diameter and operating at a wavelength of 8 millimetres cannot separate a group of aircraft on its screen at a range of 5 miles unless each plane is separated by at least one quarter of a mile from the next.

INDIVIDUAL MOTORS!

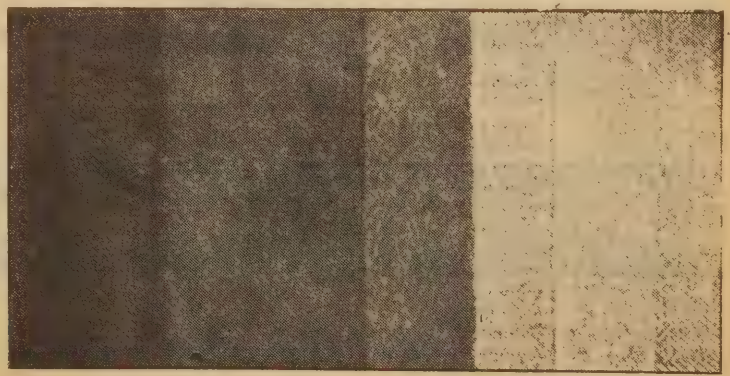
An infra-red detector however using a mirror only 4 inches in diameter to collect the rays can pick out the individual engines on an aircraft at the same distance.

Infra-red detectors usually take the form of an optical and electronic system. The detector itself, the device which collects the infra-red rays, is very small, being about one millimetre square.

This small device is placed at the focal point of a mirror system and in this respect is similar to a micro-wave receiver.

The rays to be collected fall on to the surface of a concave mirror. These are reflected back to another mirror which again concentrates the rays into a beam and reflects them back through a hole in the first mirror. From here the rays are concentrated on to the detector, after passing through the blades of a chopper.

This chopper alternately opens and



You might not think so but these are all pieces of black cloth. The difference? They have been photographed using infra-red rays.

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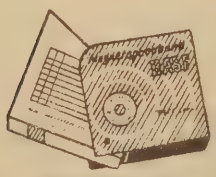

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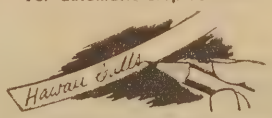

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loses the aperture through which the nfra-red rays pass into a black body eference source. This black body is a levice which itself radiates absorbed nfra-red rays and the temperature of vhich is accurately controlled.

Thus as the aperture is alternately ppened and closed by the chopper, the letector device alternately picks up radiation from the target and radiation from he black body, the intensity of the latter eing accurately known. Output from the letector is therefore an alternating signal, whose peak to peak voltage is proortional to the difference between the ontrolled radiation from the black body nd the radiation from the target.

THROUGH AMPLIFIERS

(I have rung in this technical explanation for the benefit of the technially minded reader. There is a diagram ppended which may be of assistance.)

After the detector has picked up the ays they pass through amplifiers and o on to be dealt with and analysed ccordingly.

In tracking missiles the infra-red dector is used during those phases of ight where radar is of little use. Actully there appears to be no other equipent which can be used at this stage or, during launching, a rocket is usually rrounded by all sorts of towers and uildings which interfere with radar creens., whilst the dust and smoke deeloped by the rocket make the use of ptical devices impossible.

So important is it to the safety officers n a firing range to make sure that the issile keeps within the firing range mits that it is doubtful whether deelopment in rockets would have been progressive if such an infra-red dece had not been produced.

When being used on the firing range e infra-red detector is aimed at the cket before it is fired. Immediately ring takes place the infra-red detector once fixes itself on the flame irrespective of the clouds of smoke and dust hich accompany the firing.

There is also a closed circuit telesion system attached to the tracker, hich allows the missile to be observed hilst in flight.

AST CONTROL

So accurate is this infra-red tracker at if the missile, travelling at very gh speed, suddenly gets out of course r any reason, it takes the tracker only out 400 microseconds to regain the rget and bring the picture again to the ntre of the screen.

The value of such a tracking device at once evident, for it can be used her from the ground or installed in aircraft to track high speed manuvring targets by night or day.

The infra-red detector, as explained ove, can only be used within certain nits because of the attenuation effect the earth's atmosphere. However, the nits are fairly wide and enable the cker to follow the missile to the int where radar can take over.

When any portion of a rocket or ier missile re-enters the atmosphere, at is generated in sufficient intensity this tracker to locate it and guide servers to the region where the frag nt is likely to be located.

SMALL BOAT RIDES CLEAR OF WATER

Christened "The Bat" this small snub-nosed boat has been produced by the American firm of Roberts Industries. Foils, bent from extruded aluminium, are attached to the sides of the boat. At speed, they lift the hull clear of the water. The makers claim that they give a much smoother ride and increase the speed of the craft by 100 per cent.

Since the development of the infra-red detector many industrial applications have been devised. An outstanding example of the sensitivity of the device is the detection of hot axle boxes in trains travelling at very high speed.

Everyone knows that much time is spent in repairing axles of trains which have been damaged because the grease has run out of a bearing box located at the end of the axle.

How often has one seen a train travelling at high speed through a station with smoke streaming from such a box?

Obviously the driver or guard have no means of knowing and the damage is done by the time they find out.

Infra-red detectors located at strategic points locate the hot box immediately at speeds which may be 70 to 80 miles per hour. The information is then signalled to the next station where the train can be stopped and the trouble rectified.

INDUSTRIAL USES

As an instrument for controlling temperatures in furnaces and other heating devices in the manufacture of textiles, glass, ceramics, paper, plastics and so on the infra-red detector is invaluable.

As mentioned above an infra-red detector can make corrections in 400 micro seconds. It is therefore used to measure the variations of temperature throughout a rotating body.

Unknown substances are now being identified by means of the infra-red spectrometer which studies the molecular structure of the substance.

The spectrometer consists of a rock salt prism through which radiation from a special infra-red radiator is passed to a mirror, which concentrates the rays through a slit in another mirror and on to an instrument which converts the energy into electrical impulses and actuates a galvanometer.

Thus it is useful for the study of the deeper layers of the body for cancer research and the study of the blood vessels and internal organs by electronic means or by photography.

CRIME DETECTION

Crime detection has made a great step forward by using infra-red to detect forgeries of documents and paintings.

When a painting has been overpainted with successive layers of paint, it assumes different characteristcs from the original painting.

These characteristics have different effects on the penetration and radiation of infra-red and can be observed with special detectors.

The composition of the paints used say in the time of Leonardo da Vinci exhibit different effects on infra-red radiation from the paints used at a much later period. Thus a painting supposed to have been executed by a painter of a particular period can be examined for possible forgery.

In the examination of documents for forgery, wording which has been erased and overwritten often shows up clearly in infra-red radiation.

(Continued on Page 121)

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Technical Review

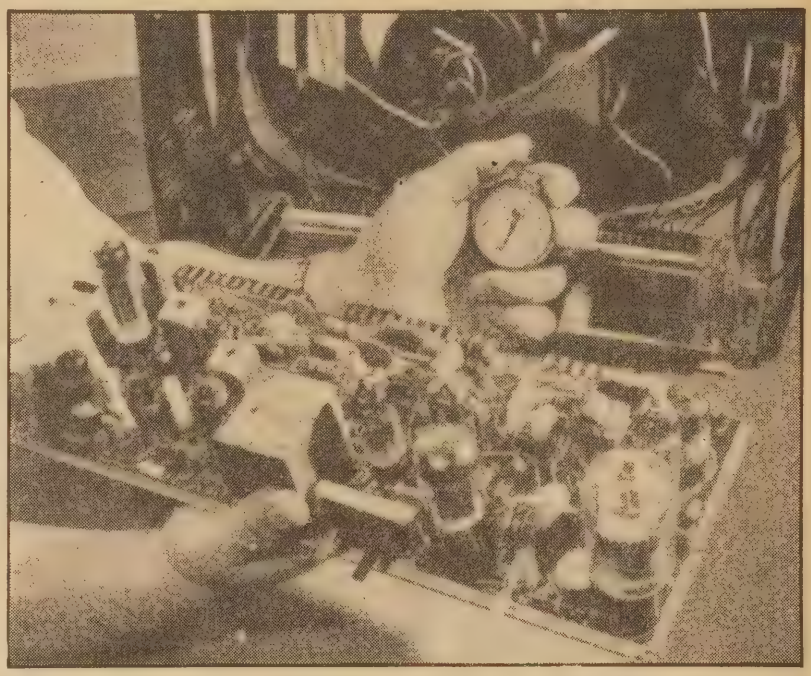
NEW TV CIRCUIT BOARD IS PRINTED IN FULL COLOUR

A complete colour-coded printed circuit, developed by Motorola for a portable TV set, makes the job of tracing leads actually easier than working with hand-wiring.

RESEMBLING a roadmap, the circuit board is printed in red, yellow, blue, reen and black, plus the natural colour the copper leads.

The circuit board provides a total of individual colour-code combinations lead identifications following the well-nown EIA standards.

The 6 by 14.5-inch colour-coded cir-it board contains the TV schematic, n which every circuit can be traced om either side. Transfer of opposite-de colour plating to observed side with ack coding makes the plated circuit a ngle-sided board on each side



A single color-coded printed circuit board contains the complete TV circuit. It takes only half a minute to remove the board from the chassis.

There is no need to turn the board er when tracing connections

This innovation in printed circuitry ll be used in one of Motorola's 17-inch rtable TV models, designed, developed d built under the direction of Chief ngineer Karl Horn, of Motorola.

All connectors between the plated cir-it board and its power supply and as-ciated receiver parts with the exception four simple clip connectors are made inserting the board into three special nale connectors with 12 contacts each

Thus the board can be removed from set by loosening three screws, dis-nnecting four clip leads, and activat-a spring loaded lever device which cts the board.

Complete removal of the board or osening it for trouble shooting takes either case about half a minute

All components are easily reached and parts in the circuit can be tested by nply removing the back cover of the set.

The entire bottom of the set is com-tely clean, with no obstruction to hin-the service man in his trouble shoot-

The board is reinforced with fibre-ss for improved strength against im-t and flexing.

More than 20 sets were tested through 20 cycles each. Each cycle consisted of immersion of the set in a cold chamber at —40 C for four hours and then immediate immersion in a humidity chamber at 85 C and 95 per cent relative humidity for 16 hours and then an operational test of four hours at room temperature.

In addition, 45 more sets were run for 4,000 hours under special cycling conditions at a line voltage of 135 v. which is equivalent to a normal usage by the average customer of 10.8 years.

Also, a battery of the usual tests such as flexing, peel strength, corrosion, salt spray, insertion and removal tests and contact pressure tests were applied to the board. Results showed a high degree of reliability and ruggedness.

INSULATING TAPE MASKS PLATING

PRESSURE-SENSITIVE insulating tape is an effective electroplating mask, according to John Gombos Co., Inc., Clifton, N.J. Photos (not reproduced here) demonstrate its use in selective copper flash and gold plating of gyro frame areas to be soldered. The firm also uses the technique in other types of plating.

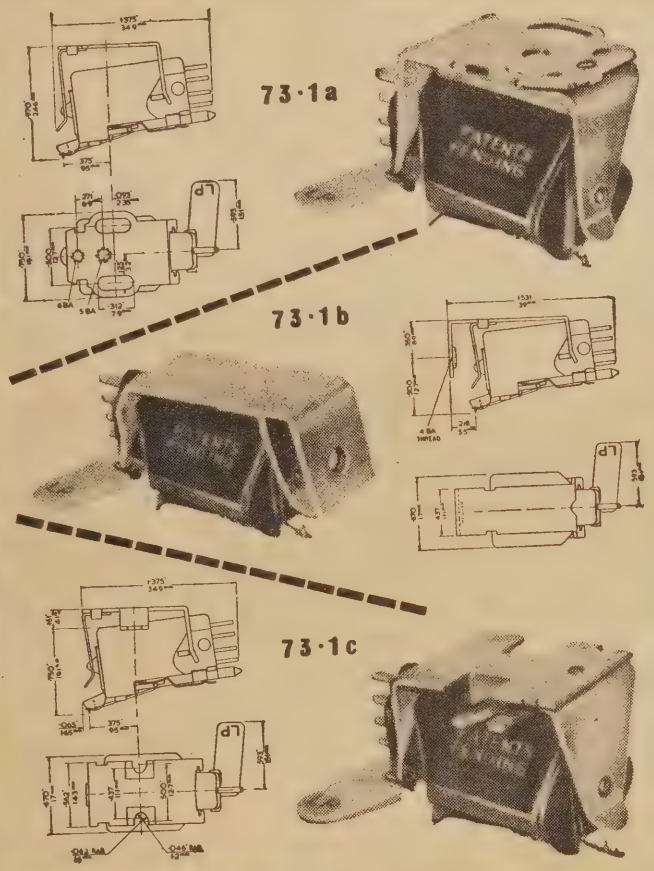
Metal will not be plated on the tape. It conforms to irregular surfaces. Masking errors can be readily corrected by stripping and retaping. Taping avoids any preliminary masking which paint-on masks might require. Baking and chemical stripping, which might affect the plating, are not needed.

After plating, the tape is stripped off. The edge of the plated area will not peel if the parts were clean and the copper flash is sound. The plated metals will not adhere to the tape.

One-inch tape (Minnesota Mining and Manufacturing Co. 470, or equivalent) is used. A nonconducting tape is required to avoid plating through the tape.

The tape is applied in parallel strips ending a fraction of an inch away from the edges of the area to be plated. The edges are trimmed with tape placed along the edges.

Sufficient overlap is allowed to prevent any gaps or paths through wrinkles in the tape. Rubber plugs can be used to individually mask holes. (From "Electronics.")

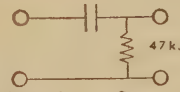


acos

Crystal stereophonic cartridge

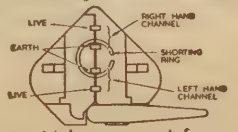
The "ACOStereo" 73-1 is a universal cartridge designed to play stereophonic and monophonic discs, including 78 r.p.m. coarse groove records. Three brackets are available. The "a" bracket fits the majority of arms, the "b" bracket fits Garrard RC. 110 and RC. 120 changers, and the "c" bracket is intended for American arms of the VM type.

The output from the "ACOStereo" 73 is flat when fed into a 2Megohm impedance. If record compensation is available in the amplifier, it is advised that the output is converted to constant velocity characteristics by feeding through this circuit:— 520pF



The left-hand channel is defined as the channel reproduced by the left-hand speaker when viewed by the audience, and is recorded on the left-hand groove wall when the record is viewed as:—

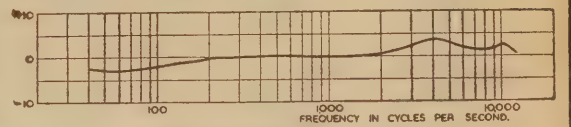
The "ACOStereo" cartridge connections as seen from the rear:—



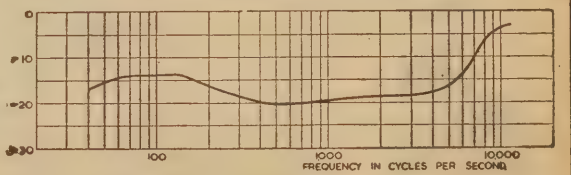
The shorting ring should be removed for use with amplifiers requiring separate leads.

PERFORMANCE OUTPUT — 160 m.v. at 1 cm/sec.
Average — 300 mv.

FREQUENCY RESPONSE—
40—12,000 c/s.
SEPARATION between channels at
1 K/cs better than 20dB.
Radii of Stylus tips—0.0005" (13.5 microns).
0.0025" (62 microns).
Recommended load: 2 Megohm.
(Compliance equals 3.5 ucm/dyne).
(Stiffness equals 0.0286 x 10 dynes/MM).
Recommended downward pressure: 3-4 Grammes.
The Stereo recording characteristics is within ½dB of the RIAA/BS 1928/1955 characteristics, and cross talk is better than — 20db at 1 K/cs



Frequency response on PS.131.



Separation between Channels on PS.131.

The response of both channels will be within 3dB.
All 73 series cartridges are available with two sapphire, sapphire and diamond or two diamond styli.
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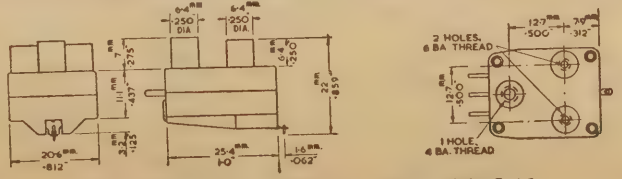

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SYMPOSIUM FORSEES ERA OF "THINKING MACHINES"

As distinct from electronic computers, now well-known and widely used, a new field is being opened up, devoted to what are often called "thinking machines." The following is a report from "Wireless World" on a recently held symposium dealing with "The Mechanisation of Thought Processes."

ELECTRONIC computers are capable of doing arithmetic at incredibly high speeds, but are passive slaves whose actions have to be determined in advance by a human programmer. The jargon word for it is "deterministic."

By contrast, machines described at Teddington were capable of solving problems which the designers themselves could not solve. As distinct from the "deterministic" computers, they worked on "probabilistic" principles, rather as human beings do when making intelligent guesses.

The main practical interest in these "intelligent" machines is the possibilities they seem to offer of advanced forms of process control in industry and automatic piloting in aircraft.

In particular, the ones known as "learning machines" have the advantage over existing control systems of being able to profit from past experience by trial-and-error method of working.

INDUSTRIAL CONTROL

As a result they should be capable of controlling industrial or other processes which do not lend themselves to a precise mathematical analysis.

In essence, the mode of operation of the learning machine is tentatively to try various patterns of control action in a random fashion, reinforcing those which give satisfactory results and inhibiting those which give unsatisfactory results.

An outline illustration of how this could work in practice was given at the symposium by A. M. Andrew in his paper, "Learning Machines."

The block diagram shows the essentials of a continuous process industrial control system with raw materials flowing in on the left and the final product emerging on the right.

Variables such as temperatures, pressures and flow-rates are regularly monitored and the information is used by the "controller" to make suitable corrections to the process.

The transducer on the right measures to what extent the final product has the desired properties (which might be, say, quality or quantity).

"RANDOMISER" CIRCUIT

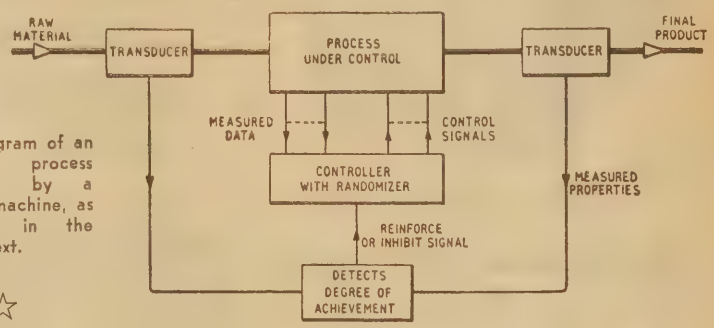
So far this is quite conventional, but the "controller" also contains a "randomiser," the purpose of which is to try different methods, of interpreting the measured information. More precisely it varies the values of the mathematical functions by which the controlling signals are related to the monitoring signals.

When the final product tends toward the desired properties, as a result of a fortuitous trial by the "randomiser," the transducer on the right causes a signal to be sent to the "controller" which reinforces the control action leading to this result.

If the product tends in the other direction because of an unlucky random trial, an inhibiting signal is sent to reduce the control action giving rise to the unwanted tendency.

This "approval" or "disapproval," as it were, of the randomly selected control patterns may also be made partly a function of the raw material properties, as indicated by the transducer on the left.

Thus the learning system adjusts itself, not, as in a conventional control system, by using predetermined functions of the physical variables, but by using any convenient functions which lead to optimum conditions in the final product.



Block diagram of an industrial process controlled by a learning machine, as discussed in the text.

☆

The terms "reinforce" and "inhibit" used in the foregoing are just convenient words to describe the processes concerned. Dr Andrew suggests several different methods of instrumenting them in his paper.

One method is to discover, on a statistical basis, what patterns of control action are associated with goal-achievement signals from the final-product transducer. This type of computer, however, works on a two-state "yes-no" principle and is not really suitable for continuously varying quantities.

NEW SYSTEM

A more straightforward method of association, which Dr Andrew is hoping to use in practice, is based on correlation computing. Here the idea is to making running correlations between the degree of goal-achievement in the final product and the values of the random mathematical functions tentatively tried out in the "controller" of the block diagram.

If there is a positive correlation between the variation of one of these values and the variation in the final goal-achievement then the learning system increases the value concerned (i.e., reinforcement). Conversely if there is negatively correlation the learning machine decreases the value (inhibition).

The "yes-no" or "conditional probability" type of computor has been demonstrated, purely for illustrative purposes, as the "brain" of a mechanical tortoise which follows a complicated boundary between black and white areas.

Here the learning system forms associations between the "black" or "white" signals, which the tortoise picks up from its photo-electric receptors, and the corresponding signals indicating the "right" or "left" movements which it makes to regain the boundary.

As in the industrial process control system, the correct associations are formed by applying reinforcing or inhibiting signals to the control patterns according to the degree of goal-achievement, in this case, regaining the boundary.

Thus the tortoise can "learn" different patterns of association between its sensory perceptions and its motor activity. As a result, it can cope with situations such as reversal of the positions of the black and white areas or reversal of the steering linkage.

Similar flexibility of action is achieved by this type of learning machine in another sphere of "intelligent" automation —the recognition of patterns. This will have practical application in devices for translating hand-written characters into speech or print, speech into typescript, or similar visual or acoustic stimuli into mechanical activity.

The great problem in pattern recognition is to be able to imitate the human faculty of recognising patterns even if badly distorted or placed in unfamiliar positions or circumstances.

Most people can recognise, say, the letter A upside-down in a line of type but a character-recognising machine working on purely "deterministic" principles would be completely lost. Not so a "learning" character recogniser of the kind now being developed by W. K. Taylor at University College, London.

"LEARNS" TO READ

Here the general principle is that the machine learns to classify various distorted or unfamiliar versions of the patterns with the normal forms, so that, on occasions when a distorted or unfamiliar version is presented to the recogniser, it still gives the correct output signal.

The machine uses a matrix of photo-multipliers as an "eye" to analyse the pattern presented into small black and white areas. The learning mechanism it-

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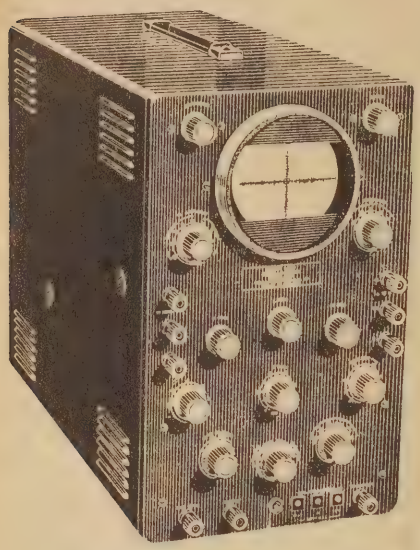

MODEL 1071K (Above)

Double-Beam Oscilloscope Kit Set

When assembled, this model is a high grade double-beam oscilloscope, incorporating five printed-wiring boards and ten miniature valves. Features include a wide range of time-base speeds, fly-back blackout and an X amplifier for internal or external voltages. The two Y amplifiers (d.c. to 3 Mc/s) are identical and preceded by switched attenuators. Facilities for intensity modulation are provided.

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MODEL 1044K

PRICE £29/-/-
(F.O.B./F.O.R. Sydney).

MODEL 1045K (Above)

Single-Beam Oscilloscope Kit Set

This single-beam oscilloscope kit can be assembled to provide a useful instrument incorporating two printed-circuit boards and nine miniature valves. Features include X and Y amplifiers of high gain and broad frequency response a wide range of time-base speeds, fly-back black-out, a calibrating voltage and facilities for intensity modulation.

PRICE £74/17/6
(F.O.B./F.O.R. Sydney)

Valve Voltmeter Kit Set

This kit can be assembled to provide a robust and compact instrument. It is designed for accurate measurement of d.c. potential, a.c. r.m.s. and peak-to-peak potentials and resistance. The valve voltmeter has many advantages over the non-electronic volt-ohmmeters. The most important of these is its low loading of high-impedance circuits such as resistance-coupled amplifiers, oscillator grid circuits and a.g.c. networks.

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lf, based on a study of the octopus, These are connected together to per- it an action corresponding to the facilitation of synopses" which is nought to be a possible basis for learning animals and humans.

It simply means that certain junctions etween nerve cells have their ability to ansmit nerve impulses increased by the rocess of learning, and the pattern of ese "facilitated" transmission paths is stored representation of what is learn- l—a memory.

Such a learning machine as this is ready too cumbersome for practical aracter recognition—not to mention e new version with 4,000 model nerve lls which Dr Taylor is now building. ut once a pattern of transmission paths as been learned for a particular charac- r-recognising application, this can be uilt into a much simpler machine as a rmanent and static "memory."

A small machine of this kind, which n be considered as a "frozen" version the learning machine with no wers of self-improvement, was de- ribed by Dr Taylor in his paper Automatic Control by Visual Signals." Instead of the photomultiplier "eye" uses a television-type scanning system, it it does not, like certain other aracter recognisers, analyse the pic- re elements on a two-state basis which ys that each one is either "black" or hite."

MPROVED RESULTS

It preserves the analogue nature of e picture elements, containing as they varying proportions of black and hite, right up to the final stages of e recognition process.

This is claimed to give improved re- lts because the output signal produced a distorted character is only reduced approximate proportion to the amount distortion and still remains active un- ss the pattern has a new significance reaches 100 per cent distortion.

Incidentally, those purists who object anthropomorphic terms being applied mechanical devices would have been ghly shocked at this symposium Words like "thinking," "learning," ntelligence," "memory," "recognition" ere bandied about quite freely by ientists who (some might think) ought have known better.

It was probably Dr A. M. Uttley uperintendent of the Control Mechan- ns and Electronics Division of the ational Physical Laboratory) who set e tone of the occasion. He remarked ght at the beginning that if we allow ch terms as "flying" applied to aero- anes there was no reason to object to hinking" applied to certain other achines.

SOLAR POWER

A WORKING model has been pro- duced of a solar-powered thermo- ectric generator for use in space hicles.

It was shown at the Summer Meeting the American Institute of Electrical ngineers by two research engineers, iles Schuh, of Westinghouse, and Ralph llent, of Boeing.

The generator weighs 3lb, is 20in long d converts solar heat into 2.5 watts of wer.

The generator shown at the meeting d a reflective aluminium sheet mount- on a 20 x 50in semi-cylindrical shape collect the sun's energy and concen- ate it on the thermoelectric material.

NEW TYPE OF POWER TRANSISTOR

A new transistor structure, described by Herbert Nelson in RCA Review, June, 1959, p. 224, has a geometry that augurs well for the improvement of silicon power transistor performance.

THE new geometry should benefit transistors made of gallium arsenide and other materials where surface recombination tends to be extremely high.

The base region, Fig. 1A, is brought to an external surface through the central region of the collector. This configuration is characterised by a high degree of minority-carrier conservation and surface immunity.

Called a surface-immune transistor, the device effectively eliminates the recombination of injected carriers on the surface between the emitter and the base-lead region. Such recombination is particularly troublesome in conventional silicon transistors.

In the new structure, the flow of base current is inward from the emitter and collector perimeters to the base lead. A forward-biasing effect crowds injection towards the central area of the emitter where no opportunity for surface recombination exists.

Several lots of experimental silicon transistors of the new geometry have been prepared and tested. Results also show that the base and saturation resistances are considerably lower than those of comparable conventional units.

The current transfer ratio of the conventional units vary greatly with surface changes, while that of the new geometry remain substantially unchanged. The current transfer ratio decreases with an increase in the width, L, of the internal base-lead channel. When the normal and inverted operation of two surface-immune transistors are compared, results show a high degree of symmetry.

Results also show that values for an inverse current transfer ratio are not greatly lower than of the normal current transfer ratio. An inverse current transfer is more affected by surface treatment than is the normal current transfer. This is probably caused by surface region M (see Fig. 1A) which should have greater effect upon minority carrier loss in inverted than in normal operation.

The low saturation resistance of the surface-immune transistor is strikingly evidenced by the early sharp rise of collector current with voltage. Saturation resistances of the surface-immune and the conventional units are 0.4 and 2.5 ohms respectively.

Importance of the structure is less for transistors made of germanium where surface recombination can be low.

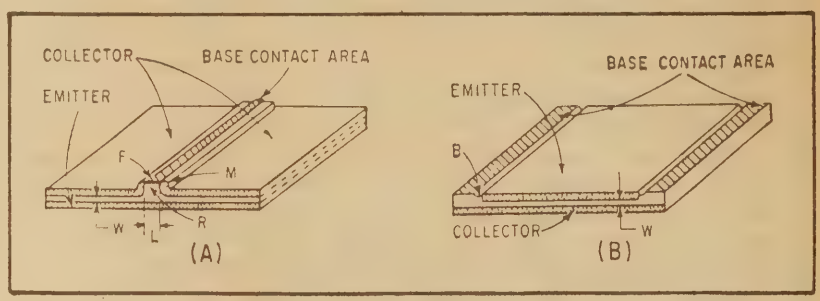

FIG. 1—New transistor structure, A, compared to conventional transistor structure, B.

"PRINCESS" PACKED WITH RADIO

(Continued from Page 15)

picks up a portable lifeboat transmitter-receiver. This includes a collapsible 15ft aerial and is powered merely by turning a handle. It requires neither power circuit nor batteries, will float and is waterproof.

Passengers on the "Princess" will be electronically entertained, too. Radio and TV are controlled from the bridge. The TV has an amplifier for each of the three channels and the radio officer expects good reception even 200 miles from Melbourne, along the coast of Tasmania.

An additional entertainment service can be fed through from a record-player in the purser's office. There is a public address system installed there, too, for paging passengers in any part of the ship.

Even the crew have received special attention on this luxury craft. There is a receiver for their use only. It is operated by a time switch which flicks it on and off by clock.

Or, should the crew members prefer their own private radios, the pantenna is at their service. This is a special aerial which has about 70 outlets. There is a plug in every crew-member's cabin and the ship provides the extension from wall to radio.

And, of course, the captain can talk from the bridge through an amplifier system to the crew or the passengers.

The vehicle deck, one of the main features on this passenger-ferryboat, runs the entire length and breadth of the vessel. And here, too, is a handy piece of equipment; a talk-back, on which the operator can direct motorists fore and aft in driving their cars aboard.

And, once aboard, he can give them instructions for parking and anchoring their car by the four-way anchoring device.

Once parked the passenger can forget his vehicle and settle down to enjoy the all-night voyage to Devonport, Tasmania, on the gyro-stabilised "Princess," assured that everything has been done, electronically, for his comfort and safety

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A comparatively new name in this field, yet already establishing a firm reputation for quality equipment. The amazing new compact stereo amplifier and control unit MODEL A1444 offers quality in stereo reproduction from crystal pickups, tape or radio, at the unbeatable price of £59/18/. This unit features separate bass and treble controls and is easily adaptable to cabinet, tabletop or bookshelf mounting.

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Amplifier Specifications: Push-pull output, 7½ watts R.M.S. control unit provides for stereo-mono operation with crystal pickup, tape and radio.

For monophonic use: Model 590/1 features stereo-mono control unit and one amplifier, attractively styled, mounted in a compact table or shelf type cabinet. To convert to stereo, simply fit one 584 type amplifier to the space provided in the 590/1 and you have a quality designed high fidelity stereo amplifier.

You may, of course, purchase the whole unit complete ready for stereo operation, in the form of 590/2 amplifier

Prices: Mono unit 590/1	£58	5	0
Conversion amplifier ...	£27	19	0
Stereo unit 590/2	£91	0	0

"TEN-FIFTEEN" is the name of an amplifier designed for the more discriminating. This is a superior quality unit, a worthy successor to the famous 5/10 series. Designed to give optimum results from all types of pickups, radio, tape or microphone. **£77/18/.**

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Stereo recording attachment: £33/1/.

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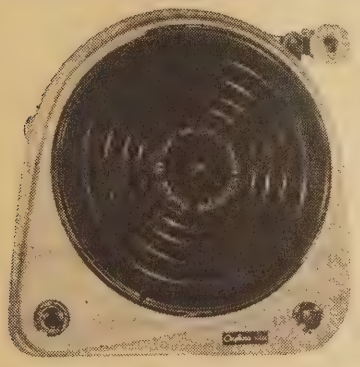

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H. T. SECONDARY—250-0-250V, 80mA
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FROM THE EDITOR—IN EUROPE

In Geneva the atmosphere has changed dramatically within the last few weeks. The population has shrunk to a fraction of its concentration in early August, it is now something less than suicide to cross a main street, the boats have ceased their journeys up and down Lake Lehman, and even the Jacobbe d'Eau, that incredible 400ft high stream of water that plumes into the sky, no longer operates.

A FEW cold days have whipped a nip into the air to remind us that, however warm and balmy the autumn days have been, winter in this part of the world is different from our own.

In many of the towns where the holiday and tourists crowds are greatest, whole hotels have closed up until next year. Just a few of them re-open when the snow and ski-runs bring the hardy ones back to Switzerland for the winter sports. It is a striking example of how much this green country depends on the tourist world for its livelihood.

The I.T.U. Conference is now at full pressure as all committees strive to complete their work before the plenipotentiary part of the conference begins in a few weeks. I'm afraid this is more of a hope than a reality, as a huge amount of work yet remains.

As of today, there have been 72 committees, working groups and sub-working groups created to handle the ever increasing flood of proposals and differences of opinion. The smaller delegations are set an acrobatic task of deciding into how many parts they are able to decimate themselves.

ENDLESS DOCUMENTS

If they are really conscientious, the task of sorting out all their documents would take up much of their time.

At present the secretariat claims it is issuing approximately one million oneod sheets of such documents every week. Nearly all of these are fated to be discarded and replaced eventually by others, which in turn will often suffer the same fate.

Somehow the garbage and disposal squads of Geneva will have to remove all this paper from hotel bedrooms which serve as work-rooms as well. Let us hope the thrifty people can devise some method of making use of this multi-coloured avalanche of paper!

The subject of high frequency broadcasting still remains the focal point of the convention. Easily the stormiest sessions have been centred around it and its consideration by a special study group to determine whether any extensions or modifications to these bands is possible as frozen consideration of allocations between 4 and 27.5 megacycles for many weeks.

Even now, the special working groups which are about to consider the disputed frequencies in detail are not permitted to make decisions concerning broadcasting, which can only be considered in the main Allocations Committee.

The demands from "new and developing" countries for special consideration are vocal and consistent. No one seriously denies the requirements of such countries for channels to be used in cultural and educational schemes, but all the danger of commencing a reshuffle of frequencies in which no one is anxious to surrender channels or limit their own activities.

At the moment a special committee is attempting to define what is a new and developing country, and at what stage a country ceases to be new and becomes "old and decrepit," as one delegate put it. Most people at present have the feeeling that this conference is grappling with a problem, with no real solution, which will be accepted by all.

As I have said before, the real basis of the question does not lie in the terms of reference of this conference which is essentially administrative and not political. But the SW broadcasting activities which are really overloading the bands are those forced upon administrations by the Governments of the countries concerned, who demand what they consider adequate channels, mainly for propaganda.

Few, if any, of the hard-headed engineers really believe that SW broadcasting has more than a very small entertainment value, or that numerous and duplicated channels could not be closed down forthwith without noticeably disturbing the world in any way.

In fact, the delegate from China hit a sympathetic nail square on the head when he said that the world would probably be a better place if SW broadcasting were to stop altogether!

STUCK WITH IT!

The fact is that this conference is stuck with it. It would dearly like to assist the demands for fixed services and for "new and developing" countries, but it has just run out of ether space and that about sums it up. It does not see how an extension of bands would be possible except to a limited degree or how it could be a real solution.

Failure of the conference to recognise Communist China in its proceedings is, on the face of it, unrealistic but at the same time inevitable. Until the United Nations affords such recognition, it is virtually impossible for any International Administrative conference to do so.

The demands by the Russian delegation that Communist China should be admitted or at least invited as an observer began with the first sessions of the conference and have been renewed with great and outspoken vigor on every opportunity. This has three times stung the representatives of Nationalist China, who are here, into equally strong and dignified replies.

These incidents have posed severe problems on the Chairman of the meeting concerned, for it is difficult to decide and rule upon the exact line between pure politics and their undoubted effects on a conference of this type.

It is an anomaly that a country owning about 25 per cent of the world's population should have no part in deciding questions, the whole value of which demands uniformity and general acceptance by all who use the ether.

But the terms under which the I.T.U. operate make it quite clear that the conference itself cannot make decisions of this kind but must accept the position, in which recognition of Communist China as a sovereign country cannot be given.

The result has been debates reminiscent of proceedings in the United Nations General Assembly, in which the U.S.S.R., supported by its satellite group has ranged itself angrily against most of the remaining countries. As in politics, so in radio proposals, the U.S.S.R., group has been almost invariably co-ordinated and adamant in its demands.

YOU FORGOT TWO!

Much amusement was caused in one committee in which the U.S.S.R.. delegate had said his piece and automatically named a list of countries for whom he was speaking. The French delegate came back in a spontaneous flash "May I remind the delegate of the U.S.S.R., that he forgot to include Byelo-Russia and the Ukraine." Even the U.S.S.R. man joined in the joke, because, in fact, he had.

But in general the Russians have been hard-headed realists, who obviously know their subject and possess not only a genius for detail but a practical logic as well. They are not anxious to mix very freely but, without doubt, the language difficulty could have much to do with this. Many languages in Europe are intelligible in part to anyone over High school level, but Russian is quite a different matter.

One cannot but admire the facility and efficiency of the interpreters who serve at the conference. These people are professionals, of course, and are greatly in demand on such occasions.

FOUR LANGUAGES

All the major meetings, a number of which are necessarily carried on simultaneously, use interpreters for French, English, Spanish and Russian. The main rooms have four booths each, as a rule, containing two interpreters who operate in relays.

These listen to the speakers through headphones, and they translate immediately into the language they are handling, so that the translation goes on without delay into the room. They are expected to take technical terms in their stride. The complexities of numbers, megacycles, special techniques and terms must not come as a surprise to them, and all must receive the correct pronunciation, a most important requirement where simultaneous translations are concerned.

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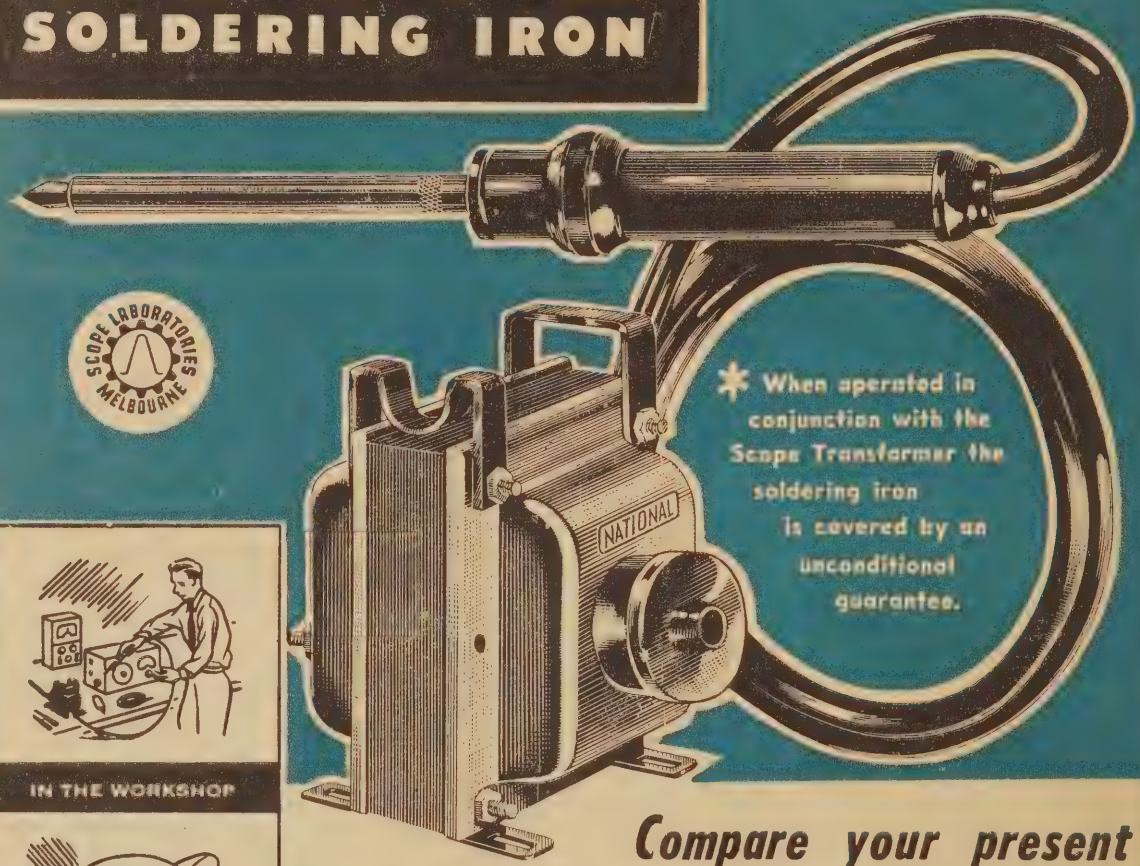

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nslating all three languages into the
irth, and to do it so well, is some-
ng to admire as an exhibition of
ental agility.

The booths and desks at which the
legates sit are fitted with headphones
each position and a small switch box
ows them to select the language they
sh to hear. There is also an individual
lume control in each position.

Each delegation in the large hall has
separate microphone into which mem-
rs may speak. The smaller rooms
ve fewer microphones which are more
ely shared.

These are controlled by an operator
o sits at a small console, follows the
bate, and switches microphones as the
rious delegates wish to speak. A system
indicator lights tells him which
icrophones are active. The micro-
ones themselves carry further lights
show when they are "on the air."

ON THE AIR"

When a delegate wishes to speak he
esses a button on his own microphone
d this illuminates an indicator lamp on
panel in front of the Chairman, who
kes up his list of speakers from it.
As might be imagined, all these oper-
ons have called for much ingenuity
d, occasionally, misunderstandings
e place. But, on the whole, the system
rks very well, has few technical
ubles. After a while, one gets quite
ed to this conception of debate by re-
te control. Nor is there any need for
delegate to raise his voice, although
casionally some do.

It is not possible at the moment to
ke any useful comments about con-
ence decisions, for these are in a state
continuous evolution and liable to
ange almost at any moment. Past
perience has shown that only when
final votes have been taken is it
lly safe or very wise to issue any but
neral comments about the work itself.
By the time the next issue arrives it
ght be possible to be more specific
such matters.

USSIA, EUROVISION

I notice that Mr George Ivanov, a
rector of Russian TV who was recent-
in Great Britain, has said that by the
d of next year he expects Russia to
linked with Britain in the widespread
ropean network known as Eurovision.
By means of this network, programs
om various parts of Europe are re-
ed and exchanged in a system of
dio links extending from the toe of
ly to the furthest parts of Britain.
though a number of differing TV
ndards are involved, an ingenious
thod of conversion allows the neces-
y interchanges to take place.

Russia uses the same 625 line C.C.I.R.
ndards as Australia and a number
other European countries.

Mr Ivanov said that, by the middle
next year, there would be a link with
arsaw and, by the end of the year,
would be extended to Prague. It
uld then be possible to link up with
itain through Eurovision.

He hoped there would then be a free
change of programs between the two
untries, although the language diffi-
lty would probably prove a barrier.
usicals, ballet, political, science and
orts programs he thought would be
table for exchange.

"Perhaps football matches between the
ssian and English teams at Moscow

(Continued on Page 55)

STEREOPHONIC EQUIPMENT

More pointers on buying

There seems to be an idea that a cheap stereo unit sounds better than a high-class monaural unit and that quality is no longer so important. We feel this is quite wrong. Far too many enthusiasts build good amplifiers and then use noisy motors, sapphire styli and cheap speakers (but with marvellous frequency ranges on their specifications). Then they find to their horror that many of the commercial units sound as good or better. The reason is simple, the commercial unit probably uses a similar pick-up and speakers. We have found the saving of £10 in £100 is forgotten and only the memory of poor sound remains. For this reason we stock only speakers, pick-ups and amplifiers which will give good results without apologising.

We now can supply any of the popular enclosures for speakers and cabinets for amplifier equipment at prices which make kits pointless. All speaker enclosures are made in ¾in wood for rigidity. The smaller enclosures now available give outstanding results for their size. This is not the same as giving outstanding results. The results may be more than satisfactory for your purposes but a good big enclosure is still better than a small one whatever the speakers.

Because of our trade-in policy we have lots of second-hand equipment which is sold at our cost. Also we have some of the best in new monaural equipment which is being cleared at extraordinary prices and could help you add a superb second channel to your own equipment rather than sell it at a loss and buy an inferior stereo unit.

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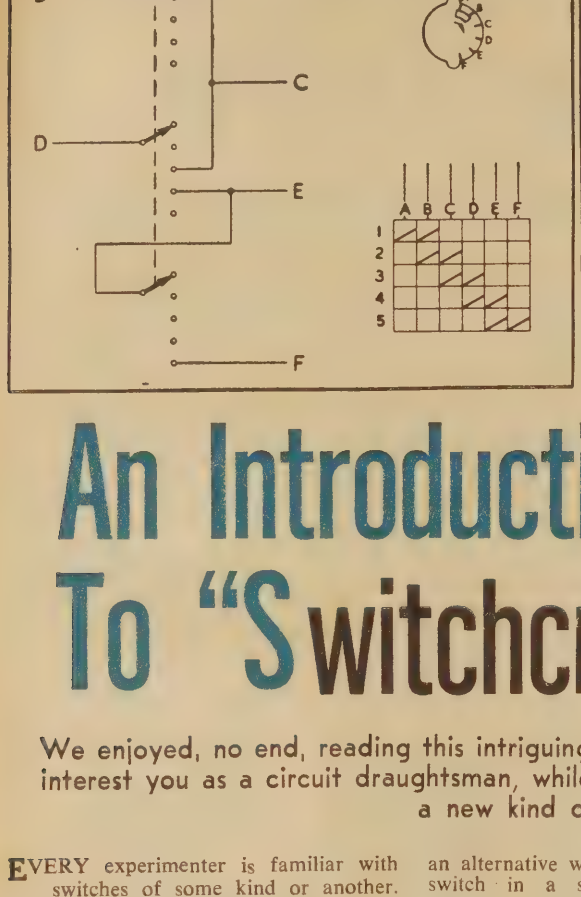


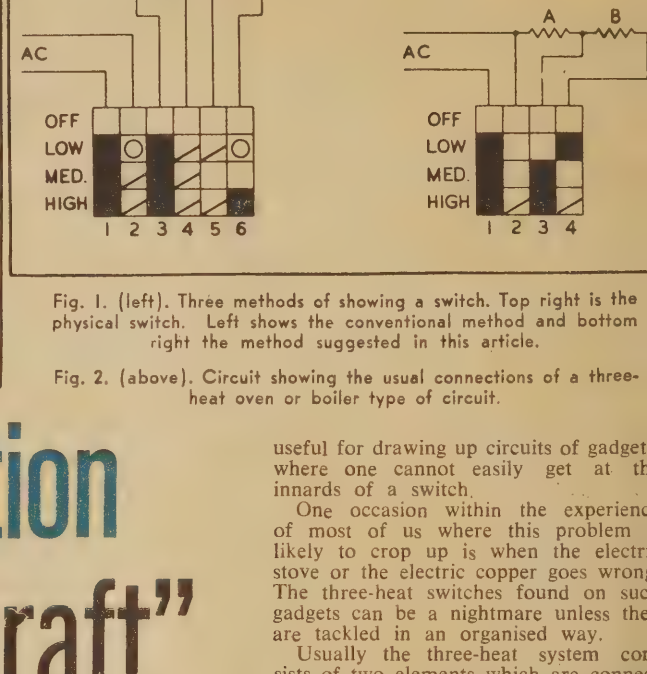


Fig. 1. (left). Three methods of showing a switch. Top right is the physical switch. Left shows the conventional method and bottom right the method suggested in this article.

Fig. 2. (above). Circuit showing the usual connections of a three-heat oven or boiler type of circuit.

An Introduction To "Switchcraft"

We enjoyed, no end, reading this intriguing article. You'll probably do the same. It could interest you as a circuit draughtsman, while away a few pleasant minutes or start you off on a new kind of electronic hobby.

By R. Hartkopf

EVERY experimenter is familiar with switches of some kind or another.

The ordinary switch is a very simple affair and its symbol appears in almost every radio circuit. It is simply an arrow "hinged" at one end and pointing to a circle.

A multi-way switch has a number of these circles and each represents a different position.

There are, however, quite a few cases where this simple way of showing a switch becomes rather awkward and also misleading. An example is shown in Fig. 1.

The sketch in the top right corner is a diagrammatic view of an ordinary wafer switch with a rotor shoe which bridges adjacent contacts. In position 1, A is connected to B. In position 2, B is connected to C. In position 3, C is connected to D, and so on.

ORDINARY SYMBOL

On the left is shown how this could be represented by the ordinary switching symbol. It is necessary to go to a five-position three-pole switch before all the possible connections can be shown.

What is worse, we finish with a symbol which gives a completely misleading idea of what the real switch looks like, and, if we are looking for a suitable switch, we are more likely to go for a three-pole five-position switch and overlook the fact that the same job can be done with a single bridging wiper.

Now look at the diagram in the bottom right corner of Fig. 1. This shows an alternative way of drawing the same switch in a schematic circuit. The method of construction is simplicity itself.

Since the switch has five active wires connected to it, we draw five wires and terminate each at the top or bottom of a vertical column. Since there are five positions we divide the columns into five sections. Then each vertical row represents a connection and each horizontal row represents a switch position.

Then, taking each horizontal row in turn, we mark the squares representing the wires which are connected together in that particular position.

If there are more than one group of wires connected together, but the groups themselves are not connected, then a different kind of marking is shown for each group. This will be seen when we look at Fig. 2.

So there it is. Simple to draw and easy to read, this methods shows exactly what is connected to what in every position.

Using this method for drawing up circuits, there is no need to stop and worry about what kind of switch to use or work out any physical details. That can be left until later. It is equally useful for drawing up circuits of gadget where one cannot easily get at th innards of a switch.

One occasion within the experienc of most of us where this problem likely to crop up is when the electr stove or the electric copper goes wron The three-heat switches found on suc gadgets can be a nightmare unless the are tackled in an organised way.

Usually the three-heat system co sists of two elements which are connec ted in series for the low-heat. For th medium-heat, one of the elements connected across the line and for th high-heat position the second element connected across also.

The left-hand sketch in Fig. 2 show how this information can be put int schematic form. There are two heate elements (A and B) and the connectio to the main giving six connections i all.

In the "off" position nothing is co nected. In the "low" position 1 is joine to 3; 2 is joined to 6; 4 is joined to In the "medium" position 1 is aga joined to 3 and 2 is joined to 4 and th is all. And so on.

SIMPLER SWITCH?

Now if we study this diagram w will see that in all live positions 1 connected to 3. Also that 4 and 5 a usually joined. If these two connectio could be made permanently it wou make for a much simpler switch. A little consideration will show that th can be done and we come around the much simpler version shown on t right-hand side of Fig. 2, where t switch has been reduced to three "mak contacts operating in sequence.

Those who are likely to become i volved with motor controllers will fi Fig. 3 worth studying. The particul device shown is a foot control for dental machine. It has a central "o position and a standby and three runni positions in both forward and reverse

The speed of the motor is varied cutting out shunt resistors across t

rmature, which is in series with the ield. The physical drawing shown on he left in Fig. 3 is complicated, has to e drawn accurately or it is useless and, n addition, means taking the foot control to pieces.

The schematic drawing of the switch hown on the right can be as rough as ou like, gives a clear picture of what s connected to what and can be made y using a buzzer or ohm meter without having to take the switch to pieces.

Another switching device which has arious possibilities is the lever key. ig. 4 gives a side view of a typical three-osition lever type key and Fig. 5 shows he schematic equivalent. "Left hand" nd "right hand" refer to the view of he key from the tag end and Fig. 4 hows the left-hand bank.

CONTACTS MISSING

The right-hand bank merely has the wo changeover sets only, the counterparts of the "make" contacts 1 and 2 nd 9 and 10 are missing.

This key forms the basis of the circuitry shown later for the "Farmers' Friend" gadget (see Fig. 8). Which aises the question, what could such a ey be used for except telephone switchoards?

Apart from model railways, intercom. ets and burglar alarms, there is another astime which, in these days of electronic brains, is likely to become increasingly popular.

This is the design and building of ogical circuits.

The term "logical circuit" has a speci meaning. It isn't merely a workable ircuit designed by an intelligent person. It is a circuit which "thinks" out ogical answers after it has been provided with basic "facts."

"Do you remember that old weather aying, "Red sky at morning, the shepherd's warning. Red sky at night the hepherd's delight?" Assuming this saying is correct, there are four possible ombinations and three possible results.

RED OR NOT RED?

Either the sky is red or it isn't, and ither it is morning or it is evening. The ombination of these facts results (allegedly) in weather which is either fine, tormy or unpredictable. The logical ircuit representing this problem is shown n Fig. 6.

A torch battery supplies the power nd there are two change-over switches, ne for the colour of the sky and one or the time of day. These are connected to three lamps, labelled "fine," stormy" and "unpredictable."

If the first switch is set to "not red," hen the "unpredictable" lamp goes on egardless of the position of the other witch. But if the first switch is set o "red," then the second switch controls he answer.

If it is set to "morning," then the stormy" light goes on. If it is set to night," then the "fine" light comes on. o now we can forget the rhyme because we have built it permanently into logical circuit!

Anyone who is optitmistic enough an build themselves a weather predictor along these lines and make it s simple or as complicated as they lease. If it works there is always the ossibility of selling it to the Weather Bureau.

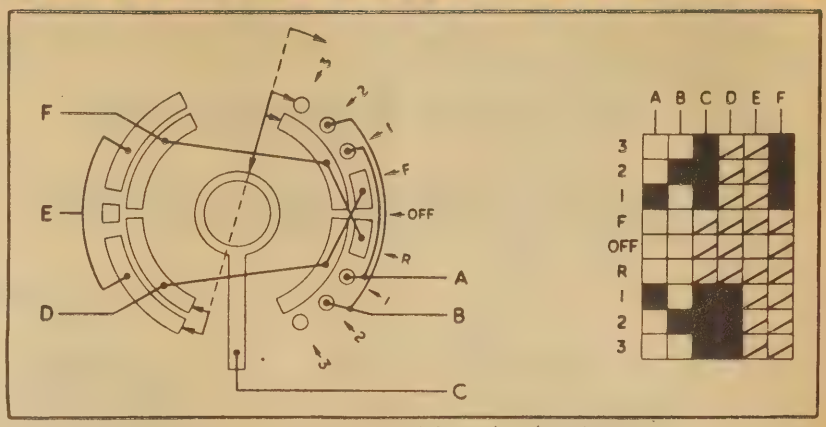


Fig. 3. The foot control for a dental engine.

Fig. 7 shows a more ambitious logical circuit. There are four switches, A, B, C and D. Looking at the left-hand circuit, we see that each switch provides two alternatives for each incoming connection. So out of A come two branches, out of B come four branches, and so on.

The way in which the branches coming from the last switch D are terminated depends entirely on the logical problem which is being represented.

In the case of Figure 7, it is a "farming" problem. The first switch, A, represents a crop of corn. B represents a pack or flock (or something) of dingoes, which are after the chooks (switch C), which are being looked after by the farmhand (switch D).

The two lights, R and G, are red for danger and green for safety.

Putting the switch to the right represents putting the object concerned in one paddock. Putting the switch to the left represents putting the object concerned in another paddock.

A study of the circuit will show that if the chooks and the dingoes are in one paddock and the man in the other, there will be trouble. Likewise, with the chooks and the corn. Every possible combination will give some answer, either the red or green light. representing safety or trouble.

Further study of this circuit will show that the switching can be simplified. If, for instance, the man and the chooks are in the same paddock, he will be able to look after things regardless of

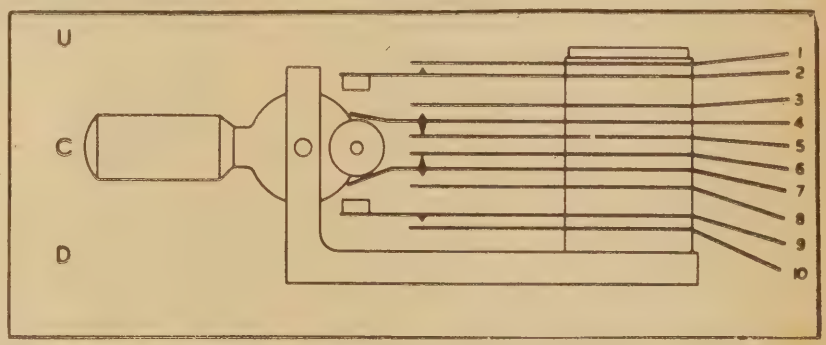


Fig. 4. A typical three-position lever type key.

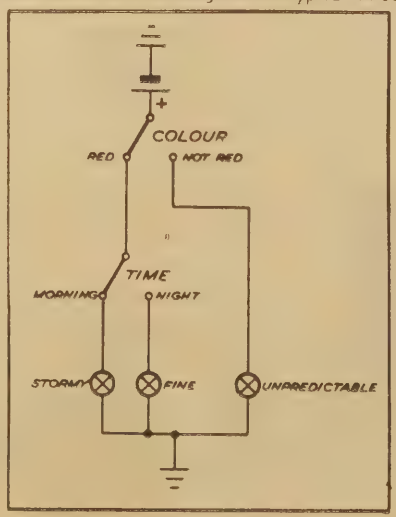


Fig. 6. An elementary "weather predicter."

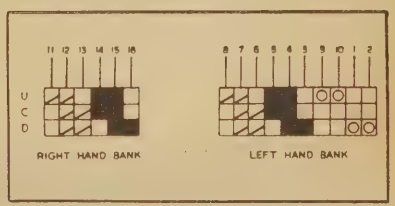
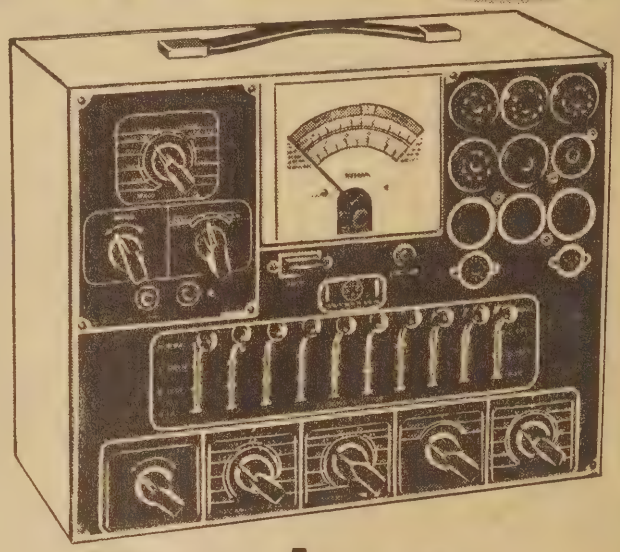


Fig. 5. Switching symbol for the key shown in Fig. 4.

UNIVERSITY INSTRUMENTS

VALVE AND CIRCUIT TESTER MODEL TST-2



This comprehensive valve tester and combination multimeter is designed to operate from A.C. mains. It combines the functions of a multimeter, output meter and valve tester.

The design of this instrument is such that it will not become obsolete as new valve types or valve bases are introduced. All the elements in the valve testing section are brought out to ten separate lever switches, allowing for individual selection of each element. Thus it is possible to apply filament voltage or test voltage to any base pin which allows for testing all existing valve types as well as future releases. The instrument is housed in a grey hammertone finished case with black anodised label.

Instruction booklet and test leads are supplied and the carrying handle lies flat on the case when not in use. Television picture tubes can be tested by using adapter type TV2. Outside measurements of the instrument are 14in x 11in x 6in.

ELECTRONIC VOLTOHMETER —TVR-EV
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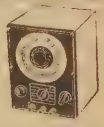

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vhere the dingoes or the corn may be. By reasoning in this way it is possible to use the circuit on the right-and side of Fig. 7 to do exactly the ame job.

This raises a fundamental rule of ogical circuit design, namely, that to implify the switching one should always put the most significant factors irst. In this case, instead of an eight-ole switch, we can get away with only two-pole one.

There can, of course, be cases where ll the factors are equally important, nd then a circuit like the left-hand one n Fig. 7 would be necessary.

Suppose we made the circuit represent a mystery car tour, the positions f the switches representing a right or left-hand turn. With the four switches

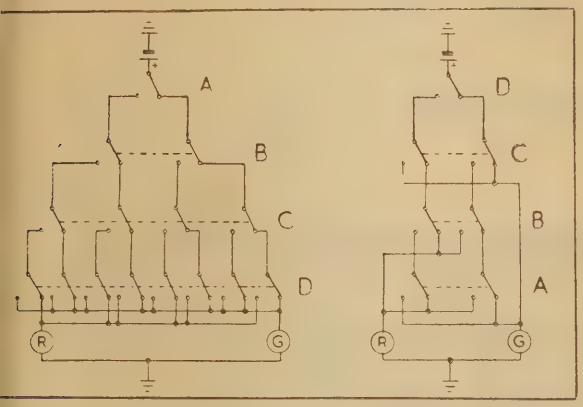


Fig. 7. Left—the basic logical circuit. Right—the same result achieved with simplified switching.

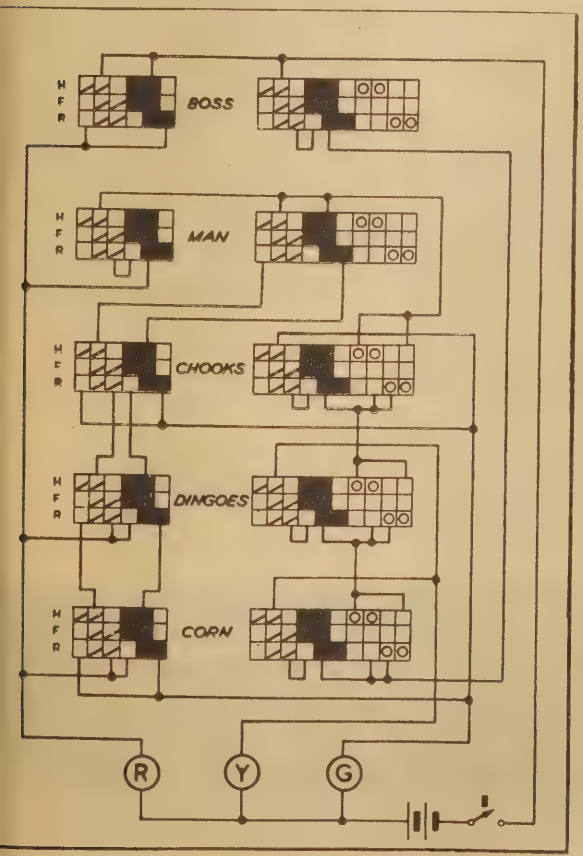
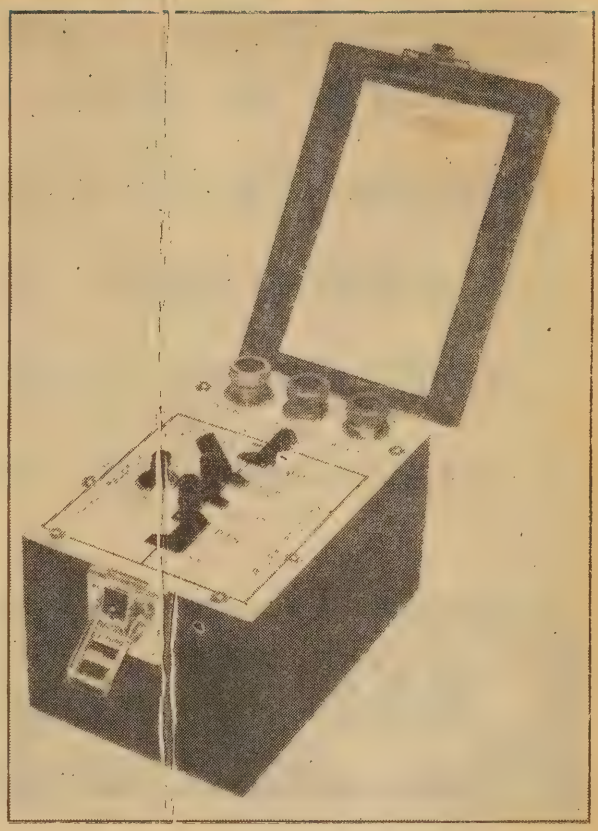


Fig. 8. The circuit of "The Farmer's Friend."

Fig. 9. Rejoicing under the title of "The Farmer's Friend," this gadget provides various solutions to the classic dilemma facing a certain farmer. In actual fact, it is an elementary example of a so-called "logical circuit." Want to build one?



it would be possible to "arrive" at 16 different "destinations."

A gadget like this would be a hit at a party. Guests could be invited to try their luck, with a prize if they arrived safely "home" and a forfeit if they finished up in the river or at the police station. The final eight-pole two-position switch would in this case be connected to 16 lamps, each of which would light up an appropriate destination.

To make it a game of skill instead of luck, a map could be made with the destination marked and the player allowed to glance at it for two or three seconds.

There is, of course, no need to stop at four switches. One can go on as long as one has switches, lamps and patience! It would be possible to make a gadget which would play the game Twenty Questions. One needs only 2 to the power 20, or 1,048,576 lamps with different designations and a switch having some 500,000 odd poles!

All of which points to the fact that the human brain must have a switching system which would make any telephone exchange look silly.

"FARMER'S FRIEND"

The final circuit of Fig. 8 and the photograph in Fig. 9 are a development of the farmyard idea shown in Fig. 7. The lever key used throughout is the one shown in Figs. 4 and 5. A simpler type of key could have been used but this one happened to be available cheaply from disposals. It is an example of how the schematic layout mentioned earlier makes it easy to think up unorthodox uses for keys or switches which happen to be available.

The main difference between this gadget—which was christened "The Farmers' Friend"—and the circuits of Fig. 7 is that, instead of two positions there are three. To the right represents being in the river paddock. To the left represents being in the home paddock and when the key is upright this represents sitting asleep on the fence.

As long as the boss stays asleep on the fence, for instance, there is hope. Let him be put into either of the paddocks and the red light goes on imme-

(Continued on Page 39)

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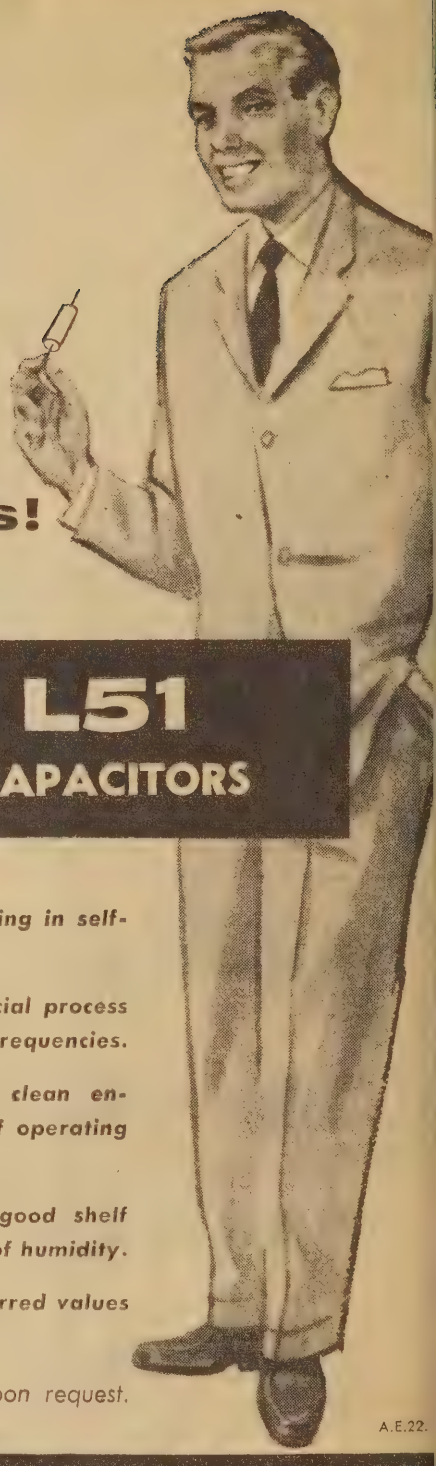

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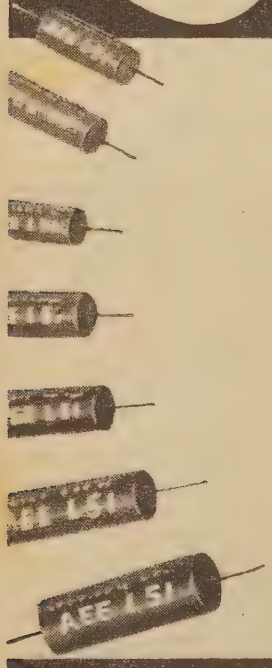

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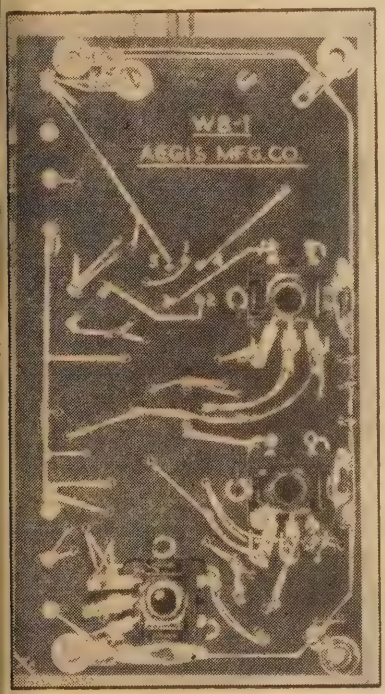
"DOMESTIC PORTABLE" RECEIVER

On a recent visit to Sydney, Mr J. H. Magrath showed us a receiver, which intrigued us enough to pass the idea on to readers. He described it as a "domestic version" of the "Transporta Six."

WHILE admitting to the utility of small and/or miniature portables, Mr Magrath made the rather obvious point that the smaller they get the more inadequate does the tonal quality become, particularly for anyone used to listening to wide-range equipment.

He contended, further, that there are plenty of people who have a use for a "cord-less" type of set around the house, or in a holiday cottage, who are not the slightest bit interested in carrying it on to beaches and in trains. But they do want reasonable quality and good battery life.



An underneath view of one of the Aegis "unprinted" wiring boards. Wires are simply added in conformity with lines printed on the board.

In other words, they want something similar to the conventional domestic mantel receiver but without dangling wires.

So why not make it possible for them to have a transistor set in a larger cabinet, housing a large sensitive speaker and with room for batteries which will last for months on end?

So he set about to build the set pictured here.

And, frankly, the quality of reproduction from it did intrigue us. It was immeasurably better than the average baby portable and better also than the majority of A.C. mantel receivers.

Possibly because the back of the cabinet was sealed with a composition board,

You probably know the appearance of this moulded bakelite cabinet very well. Fitted up with a special Rola 8-inch speaker and a "Transporta" receiver, it forms the best-sounding portable battery receiver you will hear in many a long day.

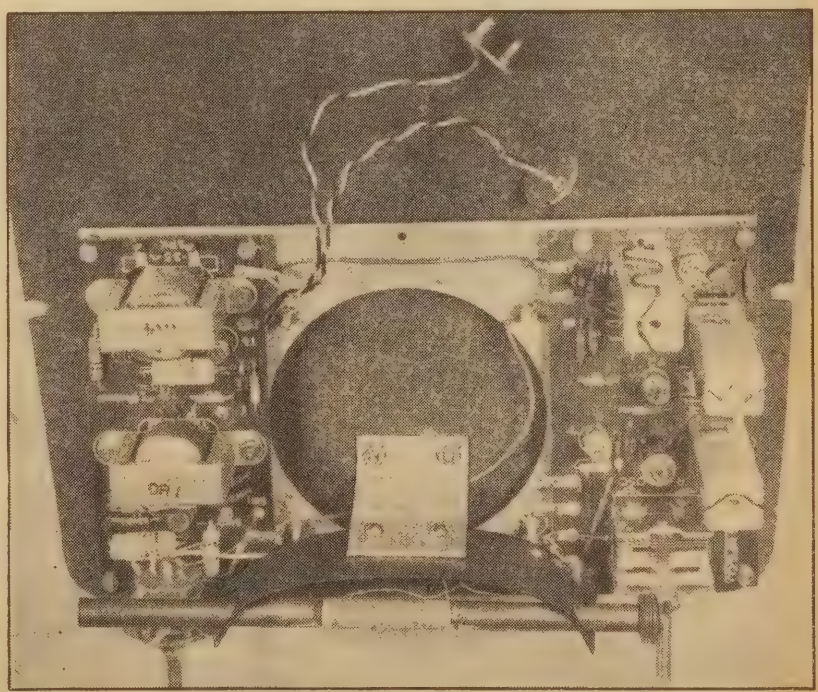
and possibly because of the negative feedback system, it even produced something that sounded remarkably like real bass!

Looking inside the cabinet revealed a Rola 8H loudspeaker with F74 cone. This is expressly designed for high-quality portable battery receivers and, despite its light weight, has a very high flux density across the voice coil gap. This ensures high sensitivity and maximum use of the power fed to it.

What it did with—and for—the B-class transistor amplifier was nobody's business!

Constructionally, the set is very simple: It uses the same metal chassis as specified for the "Transporta Six" and "Transporta Seven" receivers. Two wiring boards attach to this in the normal way, one carrying the tuner section and the other the audio amplifier.

The chassis, in turn, is bolted to a piece of composition board, shaped so



The "works" of a Transporta attached to its own metal chassis and then to a composition board back-plate, shaped to fit the cabinet. Note the method of supporting the loopstick.

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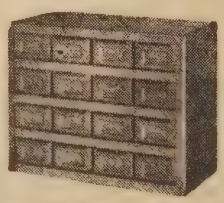

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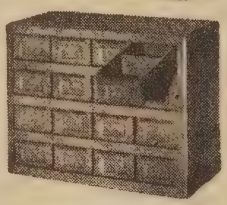

MODEL D
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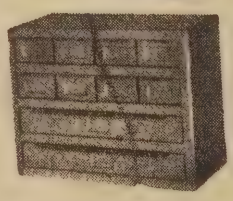
Cabinet 12" x 9" x 5½" 8 drawers 5½" x 2⅜" x 1½". 2 drawers 11" x 5½" x 1½".



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that it fits into the back of the now well-known Aegis moulded bakelite speaker cabinet. Screws and washers retain it in position.

Tuning and volume control spindles protrude through the top of the cabinet and take the moulded knobs intended for the "Transporta" series of receivers.

The aerial rod is supported as shown by a metal angle bracket, to which is attached a piece of fibre board. This has a hole in each end and is bent around so that the loopstick will pass through the holes, being held quite firmly by its natural spring tension.

SPEAKER MOUNTING

The speaker mounts in the cabinet in the normal way and is connected to the receiver by long flexible leads. Two other leads connect to a pair of batteries operating in parallel and clamped, one in each lower corner of the cabinet.

Two batteries are not strictly necessary to operate the receiver but connecting them in parallel and halving the total drain should more than double their useful life, as well as lowering the impedance of the supply source.

One other point about the particular set was interesting in that it did not use conventional printed boards.

Although having the appearance of such, the boards are merely punched in the appropriate places and coded on one side with part names and, on the other, with a pattern of lines. The constructor pokes the parts through the appropriate holes in the board and runs wires along the pattern of lines on the underside.

This is an extension of the scheme used in our own prototype "Transporta Seven" and is claimed by the manufacturer to be cheaper than printed boards.

While the receiver is available in this form as a kit, the idea can obviously be followed using any of the printed boards currently on sale.

The version shown is the "Transporta Six," which has ample sensitity for use as a domestic or suburban portable.

For use in holiday resorts or remote areas, the additional IF stage, as in the "Transporta Seven" would be well worth having.

The audio system in each case is identical.

(For constructional details of the "Transporta Six" see "Radio Television and Hobbies" for August, 1958. For details of the "Transporta Seven," see February, 1959, issue.)

'FOUR IN ONE' RADAR

A JEEP crossing the runway or a jet plane flying at 50,000 feet can readily be detected by a radar system now being installed at some R.A.A.F. bases.

First installations will be made at Pearce in Western Australia; Richmond, N.S.W.; and Laverton, Vic.; according to the Minister for Air (Mr F. M. Osborne).

The new system is known as "Quad-radar," because of its facilities in four different uses. Mr Osborne said that while the R.A.A.F. was installing Quad-radar as a a low-cost precision approach aid to guide aircraft on to the runway in bad weather, the equipment could also be used as a surveillance radar of moderate capability, as a height finder and as an airfield surveillance radar.

AN INTRODUCTION TO "SWITCHCRAFT"

(Continued from Page 35)

diately. (This circuitry can, of course, be altered to suit individual tastes.)

As long as the chooks are sitting on the fence things are likely to go well. If, however, one leaves the dingoes or the corn sitting on the fence a yellow lamp labelled "don't be silly" lights up.

A push-switch should be provided in all these circuits so that a test can be made after setting the switches and so that the lamps are not accidentally left burning.

Readers who are interested can work out all the possible combinations and results of Fig. 8 for themselves and perhaps build something with additional combinations.

The scope of logical circuits is limited only by the ingenuity of the person who designs them. The schematic diagram method of drawing switches is well worth the slight trouble needed to become familiar with it.

All the circuits have the advantage that apart from switches, the only other components needed are lamps and a torch battery.

Try some of the ideas suggested or, better still, make up new circuits for yourself and you will find you have taken the first steps in a new and fascinating pastime.

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Min. Aerial Coils paper former, in can.	4 9
Min. R.F. Coils moulded former, in can.	4 9
Min. R.F. Coils paper former, in can.	5 3
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FROM THE SERVICEMAN WHO TELLS

One of my most interesting cases this month concerns a TV set with a rather unusual intermittent fault. Fortunately, it turned out to be less frustrating than faults of this type can be, when they decide to turn really nasty. It also emphasises the part the owner can play, if he is prepared to make a few simple observations.

CCORDING to the owner, the set behaved quite satisfactorily for the ıter part of the time, but at odd inter- would suffer from ". . . bright ıes across the screen." A little ques- ing established that they really were ross," i.e., horizontal, and that they ietimes were accompanied by the pic- slipping a frame. More than that could not tell me.

Vhen I finally came face to face with set in the owner's lounge room it on its best behaviour. Only once ing my stay did it give any evidence the trouble, giving one fleeting flash ch was so brief that I scarcely saw I certainly was not able to deduce reat deal from it.

Having seen it, and waited a reason- time for a repeat performance, I to make a decision as to which was best of two possible courses to take.

HAT TO DO?

ince I obviously couldn't sit watching ndefinitely in the owner's home I had hoice of taking it back to the shop watching it there, or of leaving it ere it was and asking the owner to ke as many observations as possible r a suitable period and hope that this ht reveal some further clues.

n most respects, the idea of taking it k to the shop is the safest one, since owners are likely to be reliable ugh in their observations to be of ch help, while some may even resent g asked to do something they believe serviceman should do himself.

)n the other hand, a fault which is uliar to a particular area or installa- cannot be found on one's own work ch, and there is the very grave risk a set may be overhauled, pronounc- OK, and returned to the owner with- the fault ever having been found. urally, when the fault recurs, the 'iceman's name is "mud." There is doubt in my own mind that a percen- of dissatisfied TV customers is due his simple fact.

HAT TO LOOK FOR

or this reason, and knowing that the ıer was a reasonably observant type, lt that it would be safe to brief him what to watch for, leave the set for veek or so, then check as to what itional information was available.

explained all this to the owner, ad- that he should ring me immediately ıe effect became noticeably worse or ıe set failed completely. The latter, inted out would be the best thing that ld happen, even though it sounded er drastic.

ı the meantime I suggested he ob- e the following points:

(1) Whether the effect was more pronounced in windy weather.
(2) Whether it occurred on one or all channels.
(3) Any relation to the operation of light switches, or appliances, or to any regular period of the day.
(4) Whether it occurred soon after switching on, after a definite prolonged period, or purely at random.
(5) Any effect on the sound system.
(6) Any other effects.

Point (1) was aimed at disclosing ny possible fault in the aerial or feeder system. Observation from the ground had revealed nothing obvious, but it was worthwhile keeping a check on it.

COIL, SWITCH

Point (2), if it showed the trouble to be confined to one channel, would immediately narrow the search considerably, possibly indicating a faulty coil contact or coil in the tuner.

Point (3) is fairly obvious, and was simply to indicate whether the fault was in the set or was some form of external interference.

Point (4) might reveal an internal fault associated with the warm-up cycle of the set or one of the valves. While not necessarily significant on its own, it could add weight to other observations.

Point (5) might help to establish whether the trouble was confined to the video amplifier and picture tube or deflection system, or was in an earlier stage common to both sound and video.

Perhaps I should emphasise that I did not expect any of these observations to provide a positive identification of the trouble. At the best they might provide a clue or, by ruling out the improbable, narrow the field of preliminary investigation. This, together with—I hoped—a possible worsening of the condition might make things a good deal easier.

And, even if it did nothing else, it might indicate whether the set should logically be transferred to the service bench for further checking.

About a week later the owner rang me. He was of the opinion that the trouble was getting worse, having reached the stage where it was becoming a definite nuisance. In addition, he had carefully observed the points I suggested and was able to report that the trouble seemed unaffected by wind, occurred on all channels, seemed in no way related to switches or appliances, and occurred at purely random times relative to switching on.

AFFECTED SOUND

All of which seemed rather negative. However, he had observed that particularly bad bursts did seem to have an effect on the sound or, as he put it, ". . . the sound seems to falter." And, under the heading of "Any other effects," he mentioned " a kind of crawly pattern behind the picture, mostly on channels 7 and 9."

So with what seemed a rather meagre amount of information, I made an appointment to take a second look at the set. In the meantime I tried to analyse what the owner had observed.

While not a great deal to work on, it did seem to rule out aerial troubles or local interference, and to indicate that the trouble was most likely in the set itself. The fact that the sound apparently was affected as well as the picture seemed to localise the trouble ahead of the video detector, which was something.

As for the "crawly" pattern, I was unable to make out whether this was an interference pattern of some kind or whether it was simply noise, so it didn't help much. Nevertheless I made sure I had an appropriate set of replacement valves on hand.

QUITE A DISPLAY

For my second visit the set was much more obliging, being in the mood to turn on a display of flashes quite frequently. As far as I could see they were simply bright horizontal bands about a half-inch or so wide, containing little or no video information. And once, when there were a number in quick succession, there was some disturbance in the sound.

It was easy to appreciate why the owner had used the word "falter" in this regard, for that is exactly how it sounded.

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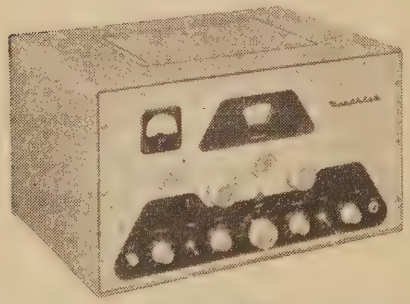

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wever, if you have ever tuned a set fast and had to wait a second or so the ratio detector electrolytic to ad- t its level you will have a better idea the effect.

t seemed fairly obvious that the sig- was being interrupted for very short iods; so short that they had little effect the sound until several occurred in ck succession. Then they resulted in effective reduction in carrier level.

Finally, the owner showed me the awly pattern." It was simply noise I must confess that I might have been ined to accept it as characteristic of set or locality had he not mentioned While I couldn't deny its presence it no worse than I have seen in many mmercial sets in particular locations. ould have classified it as well below level which the ordinary person would erve.

DISY VALVE

However, I had asked the owner to erve any abnormal conditions and, by rge, he had "observed" with a will. wever, the point was that he main- ed that the set was not like that when and, while I might have been pted to question a person's ability to ember such a condition over many nths, it was easy enough to try the st obvious thing.

simply pulled the twin triode out of tuner RF stage and replaced it with ew one. And away went the noise magic leaving a much cleaner than rage picture.

Ah," said the owner, "that's how it d to be."

Which was all very gratifying in its , but what about the intermittent that caused all the trouble in the first ce? After 10 minutes operation with ew valve in place and no sign of the hes I was beginning to wonder if I n't struck the double.

Pulling the new valve out I put the one back in place. Up came the noise before and we didn't have to wait g for a return of the flashes. But h the new valve back in place there no sign of them and I felt that it a reasonable suggestion that this ve was the culprit. Only time would lly tell of course, and I warned the tomer that it might be pure coinci- ce, making a mental note to check k in a few days time.

That was a couple of days ago, and latest report indicates no sign of the ible, the longest period without it for ny weeks. So here's hoping.

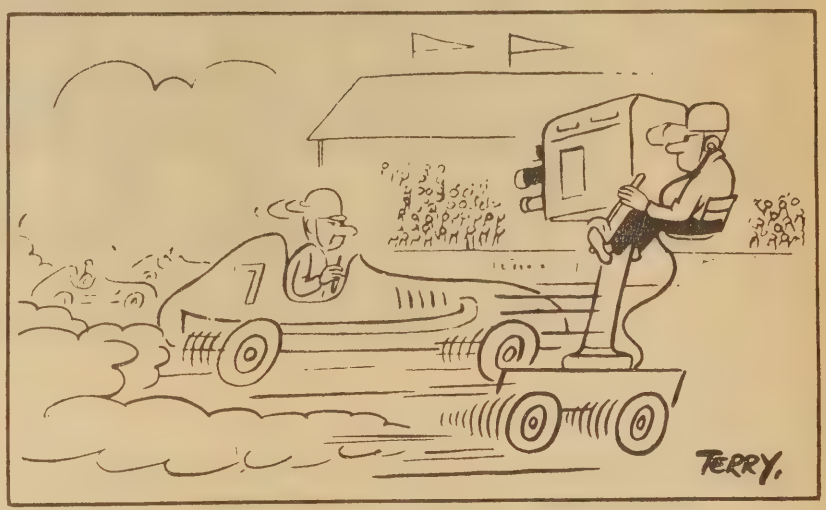
IXING" A TV SET

My next story concerns a very different d of problem. Readers may recall t, on a couple of previous occasions, ave related stories concerning the type home builder who, faced with a pro- which doesn't work, immediately the whole thing to pieces and builds gain. And not just once, but two or e times in some cases!

mentioned this subject in a general as recently as June of this year, le I seem to remember another story old in greater detail further back in distant past. The latter concerned an nusiast who had constructed a VTVM , when it refused to balance, stripped rebuilt it several times before seek- my assistance.

When he did it took me less than 10 utes to locate a single (vital) resistor which, although new, was open circuit. Replacement of this was all that was needed to cure the trouble and the owner had the grace to "kick himself" (metaphorically speaking) for wasting so much time over a simple fault.

But these stories pale into insignificance beside the one just related to me by a colleague—a technician whose job brings him into frequent contact with home builders who have purchased a kit of parts and encountered technical trouble of some kind.



It all started when he answered a phone call and found a rather distressed home builder on the other end pleading for assistance. It appeared that he had built the R.T. and H. TV set (May, 1958) and, although the set was working, he was far from satisfied.

"The picture's back to front," he wailed, "and I can't get it right. I've tried everything I can think of, it's been lined up and everything, but it's still back to front."

Then, before my colleague could reply, he hurried on, "I've pulled it to pieces and rebuilt it, but that didn't fix it either."

RIGHT TO PIECES

"What!" spluttered my colleague, his normally dignified manner completely shattered, "you mean to say you pulled a complete TV set to pieces and rebuilt it, just because the picture was back to front?"

"Aw yes." (As though it was the most natural thing in the world.) Then, by way of explanation, "Well, see, I didn't know what was wrong with it. I thought it might have been something crook in the IF section or something."

My colleague could hardly believe his ears. "But," he protested, "all you had to do was change over the yoke connections."

But this only served to add further confusion to the issue.

"Aw no, it's not that," came the firm reply, "I changed all those and it's still back to front."

"Now wait a minute," said my colleague, "let's get this straight. You say the picture is back to front. You mean it's transposed from left to right. Correct?"

"Yes, that's right."

"All right then. If that is so you need only transpose the connections to the horizontal deflection coils and the picture must come right."

There was a pause at the other end of the line. Then: "Transpose the horizontal leads?"

It was the emphasis on the word "horizontal," together with the word "all" used when describing the transposition of the yoke leads, that provided the clue to the mystery.

"Did you transpose all the connections to the yoke?" asked my colleague.

"Yes, that's right."

"Then the picture was right way round, but upside down?"

"Yes."

"So you rotated the yoke to bring the picture right way up, and then it was back to front again?"

"Yes." (With a "how-did-you-guess?" expression.)

From then on it was a matter of patient explanation on the part of my colleague as to how the yoke connections should be restored, not only to ensure correct presentation of the picture, but also to ensure minimum coupling between horizontal and vertical coils.

Since it was rather hard to establish the exact nature of the original mistake this was rather difficult, so he finished up suggesting that the yoke be rotated until the leads emerged from the bottom and that the leads then be transposed as required to give a correct picture.

A rather rough and ready guide, perhaps, but one which he knew, from practical experience with this particular unit, to be a perfectly valid one.

STILL SHOCKED!

And on that note the conversation ended, while my colleague staggered away in search of some aspirin.

But I'm afraid the incident has left its mark. Even now, several weeks later, his fellow workers still find him in a state of shock" at odd intervals. I understand he just sits at his bench, gazing vacantly into space and mutters, "Imagine pulling a TV set to pieces and rebuilding it, just because the picture was back to front. I just can't believe it."

Doubtless time will heal the scar.

Seriously, I must admit that I also, was staggered when the story was related to me. Anyone who has ever built a TV set will appreciate the amount of work involved and, if you haven't, you can take my word for it that it is a far

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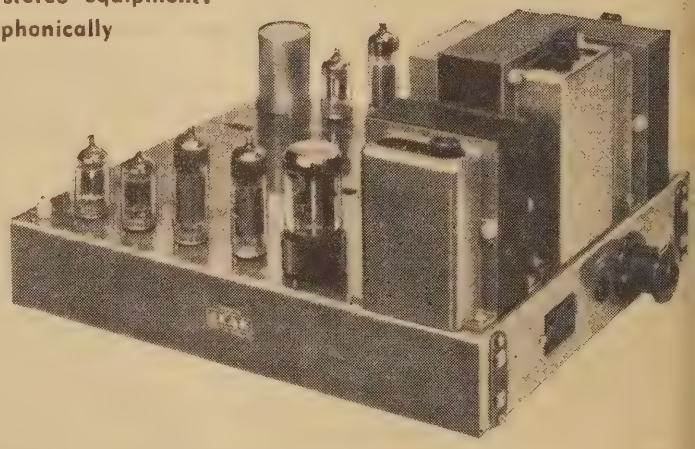

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igger job than most of us have under-
ken before.

Not that this worries the true enthusi-
st. He gets most of his pleasure from
eeing the set take shape under his own
ands, and climaxed by the thrill of fin-
lly producing pictures and sound.

But to build it the first time, spurred
n by a natural enthusiasm, is one thing.
o deliberately pull the whole thing to
ieces, reducing it to a box of scrubby
ooking components, and then to start all
ver again is quite a different matter. In
ct, were it not for this story, I would
ave doubted whether anyone could
ring himself to do it. Obviously I was
rong.

But the point which really puzzles me
the one that I have made so strongly
n previous articles. I simply cannot
nderstand why anyone imagines that
he process of stripping down and re-
uilding can have any beneficial effect.
f a wiring fault is suspected and the
uilder is so inexperienced that he cannot
nd it with a normal check, aided by ob-
ious symptoms, then — apart from the
act that he probably should not be
uilding the set anyway — the chances
f his correcting the trouble by rebuild-
ng are remote.

WILL REPEAT ERROR

In fact, everything is against him. Con-
ciously or not, he has a mental picture
f what he did before, and will tend to
epeat it. In addition, component pig-
ails and connecting leads have been cut
o a length which encourages them to
all naturally into a certain configuration
—the very one that has just been stripped
own.

If a component is at fault the situation
nay be even more confusing. If the
aulty component goes back into the
ame part of the circuit the device will
misbehave exactly as before. A lot of
ime will have been wasted and nothing
gained. But if it should be one of several
f the same value and finishes up in
nother part of the circuit the result will
e a completely different fault. Any-
hing more frustrating for a beginner is
ard to imagine.

Finally, there is the very real risk that
otherwise perfectly good components are
n serious danger of being damaged in
he process, thus producing not one but
everal faults. As components become
hysically smaller, and more heat sensi-
ive for this and other reasons, the risk
ecomes greater.

Again I'm afraid I can only repeat
vhat I have said before. Since the fin-
shed set represents a fair amount of
ard work and probably is 99 per cent
ight anyway, there is everything to be
gained by leaving it intact. The work
lready done is not wasted, while there
s a far better chance of finding the fault
vith the set intact, than there is by the
lind, brute force, approach of stripping
nd rebuilding.

A LONG SHOT

The latter, to my mind, can be likened
nly to a long shot gamble; like the first
rize in the lottery, a treble in the Mel-
ourne Cup, or playing the one-armed
andits. You have about one chance in
00,000 and you can easily go broke
vithout ever getting near the prize.

On the other hand, a fault in a set
s something reasonably tangible. Its
ffects can be observed and even mea-
ured or, as in this case, will respond to
little logical reasoning. And, finally,
it surely should be the aim of every hobbyist to tackle his faults in just this way; by observation, measurement, and reasoning.

Which brings me to my final point in regard to this particular case: the fact that the builder was unable to reason out this problem for himself.

I find this surprising not simply because a particular individual was unable to appreciate the elementary principles of scanning—after all, I can imagine many a beginner being similarly confused—but because a person could reach the stage where they apparently had enough knowledge to build a set and make it work, yet remained blissfully ignorant as to whether the fault was in the deflection coils or the IF channel!

"ANIMAL ANTICS"

And, to finish off this month, here is a little story of some "animal antics."

Animals and electronics seldom mix very smoothly; possums on power lines, cats in sub-stations etc., have all made headlines on occasions, while most servicemen have had "mouse trouble" at some time—usually in a particularly nauseating form.

But this is a different story. It is of Jo-Jo, a love bird, and who is nothing if not a perfect gentleman. Jo-Jo belongs to a colleague, and is very much a family pet; tame and well mannered enough to be allowed out of his cage each afternoon to roam about the sunroom—and even the kitchen, provided there is nothing edible in sight.

His favourite perch is the trough of the fluorescent light and his favourite trick is to toss out any foreign objects he can find. Moths and other insects which have chosen this spot as a last resting place seem to annoy his tidy mind and all are heaved overboard as quickly as he can dart from one to the other.

These antics find general approval in Jo-Jo's household. His master thinks they are smart, his mistress considers them a very practical way of keeping the lighting fixture clean, and the children get a lot of fun out of tossing small objects into the trough just to see Jo-Jo toss them out again.

All of which adds up to a very pretty little domestic picture—or, rather, it did until my colleague came home one night to find the kitchen in darkness and his wife bewailing the failure of the fluorescent light.

A routine check on the starter and the tube suggested that these were intact and that the trouble was something more fundamental. So the step ladder was fetched, the wiring of the unit examined—and Jo-Jo's sin revealed.

For Jo-Jo had not been content to toss out insects and similar objects. He had attacked one of the leads from the ballast choke, picked away the fabric and rubber insulation and, eventually, the copper wire itself.

Nor was the wire merely broken; portion of the copper was actually missing and nobody is quite sure whether he simply tossed it out or whether he took the more drastic step and ate it.

(Those who have read the account of the Kon-Tiki expedition may remember that the pet parrot had a similar taste in metals. That he did, in fact, make himself very sick by sitting on the masthead and chewing away at the end of the copper aerial wire. Maybe all parrots—and their miniature brothers, the love birds—find the flavour of copper irresistible.)

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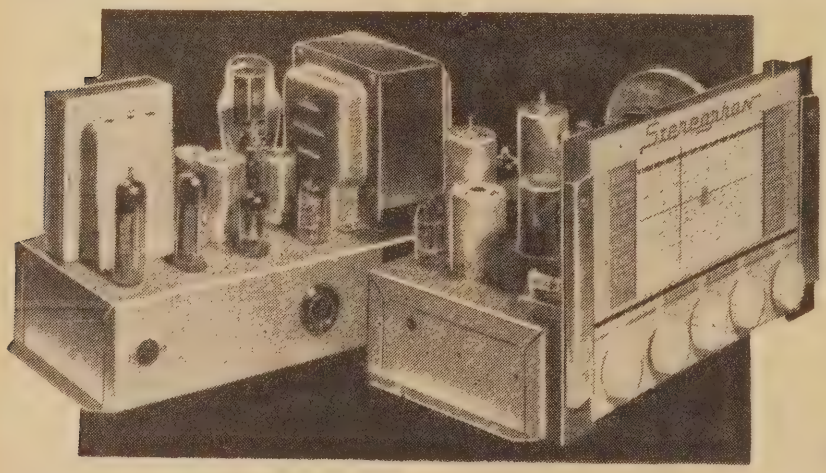
Complete stereo unit comprising dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls and two Mullard 3-3 amplifiers, power supply on separate chassis. Supplied with two Rola 8MX speakers. Power output 4 watts per channel. Frequency response of amplifier 40 to 15,000 cycles. **£48/15/-** F.O.R

8 VALVE HI-FI STEREOGRAM CHASSIS

Complete tuner and amplifier for stereo incorporating the "Mullard 3-3" amplifier circuit with separate bass and treble controls. Output 3 watts per channel. Supplied with two Rola 8MX speakers. Frequency response 50 to 10,000 cycles.

£38/15/- F.O.R



ALL UNITS INCORPORATE THE NOW FAMOUS "MULLARD" AMPLIFIER & TONE CONTROL CIRCUITS.

SPECIFICATIONS ON OPPOSITE PAGE

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Nine and ten valve chassis incorporate the Mullard E-10 AMPLIFIER CIRCUIT. Frequency response to 40-13,000 cycles. Max. output 10 watts.

£42/15/0 F.O.R.

A NEW 10 VALVE DUAL WAVE RADIOGRAM CHASSIS

WITH BASS AND TREBLE BOOST

The ideal chassis for those difficult locations where reception is doubtful. Specifications as nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short-wave bands.

£45/15/0 F.O.R.

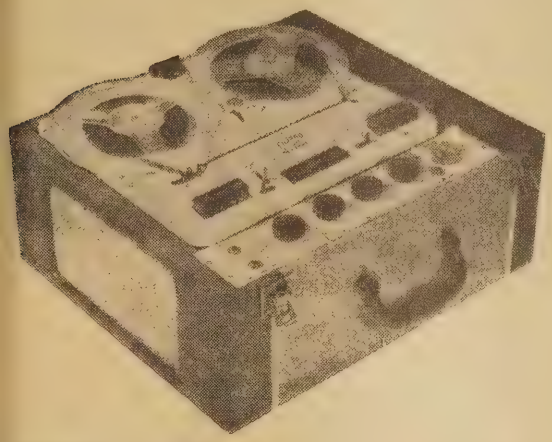
ALL CHASSIS GUARANTEED FOR A PERIOD OF SIX MONTHS. ALL 4-SPEED STEREO RECORD CHANGERS AND PLAYERS STOCKED.

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145.

Buying a Tape Recorder?

First see and hear the new Hi-Fi Recorder by Classic incorporating the new Collaro Mark IV Transcription deck. The only deck with ALL these features.



THE COMPLETE UNIT IS SUPPLIED IN ATTRACTIVE AND DURABLE TWO-TONE COVERED CASE COMPLETE WITH ACOS MICROPHONE AND FITTED WITH DUAL ROLA SPEAKERS.

The seven-valve amplifier, including level indicator, incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Record monitoring and outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with perspex dress plate to match deck.

- **HIGH FIDELITY**
Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "playback" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
- **INSTANTLY REVERSIBLE**
Instantaneous changes can be made from one track to the other. Fast rewind in either direction
- **CONSTANT TAPE TENSION**
A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan.
- **FULLY MECHANICAL**
No solenoids are used in the construction of this Transcriptor. The braking is entirely mechanical.
- **FINISH**
Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
3¾, 7½ and 15 inches per second.
- **FOUR HEADS**
Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.
- **PAUSE CONTROL**
This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
- **TAPE MEASURING & CALIBRATING DEVICE**
The three digit counter makes the location of any recorded passage the simplest of operations
- **TRANSCRIPTION TECHNIQUE**
A large diameter flywheel with ground and lapped steelshaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter at less than 0.15 to 1.0 per cent.
- **TWO MOTORS**
Each dynamically balanced motor does only one job at a time. Motors never act against each other and are of low wattage input with consequent reduction in heat and wear.

COMPLETE RECORDER WITH MIKE — 84 GNS. f.o.r.

DECK WITH AMPLIFIER, POWER SUPPLY and 6in x 9in SPEAKER, 71 GNS.

MPLIFIER AND POWER SUPPLY FOR COLLARO DECKS WITH VALVES (7) £34/10/- f.o.r.

SPECIFICATIONS OF OUR NEW HI-FI CHASSIS

NEW:

tra-modern circuit using nine high gain valves including "magic eye" ning indicator. Permatuned iron cored coils and intermediates giving exlent interstate reception and a short-wave range of 12,000 miles. All ves used are the new Mullard nine-pin Innoval series.

NEW:

ne control and audio stages incorporating the Mullard 5/10 amplifier cuit with separate bass and treble controls giving plus or minus 15 db ost or cut at 50 cycles L.F. and 10,000 H.F., combined with push-pull tput with inverse feed-back gives you really high fidelity reproduction m your radio or favourite recordings.

NEW:

al speaker combinations using the new Jensen M.S.P. 12PR woofer h matched tweeter and cross-over network giving a frequency response 40 to 12,000 cycles. If required the Rola 12MX speakers can be plied (with the 8 valve stereo chassis, two Rola 8MX speakers are plied). A.W.A. output transformers used on all units.

NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

NEW:

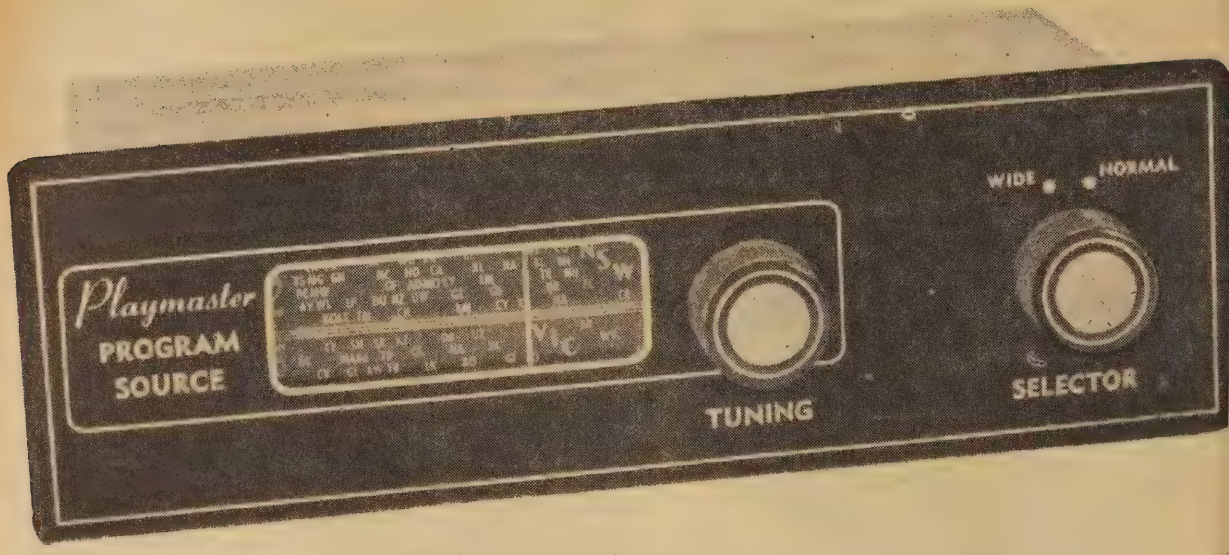
Large calibrated edge-lit dial in perspex (11in x 6in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Dial can be supplied in cream, black or brown with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control. Audio end of set can be used with TV receiver if required.

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145.



The new tuner, styled "Program Source," is housed in a box similar to that used for the latest Control Units and conforms in general styling.

A Broadcast Tuner For Your Playmaster

So you can play any record they like to bring along—and play it well—78, mono or stereo. But what happens when you want to hear a broadcast program, a concert perhaps? You borrow the mantel set from the kitchen unless, of course, you have a tuner to go with the rest of your hi-fi gear.

by Wes Yashin

LEST you think that the above introduction was thought up just for this article, let us assure you that such was not the case. The situation has been related to us by quite a few readers, in the same general terms, and particularly over the past few months.

Their prime interest is in recordings, and, for this purpose, they have invested in speakers, cabinets, amplifiers, etc., which together represent a considerable outlay and a considerable amount of bulk in the living-room.

Quite often, these folk do not want to listen to radio a great deal, but, when they do, they have to use some mediocre little mantel set, while their hi-fi gear lies idle.

"It's silly," they say; "what about a tuner to go with the rest of the Playmaster equipment?"

SEVERAL TUNERS

In actual fact, quite a number of broadcast tuners have been described in the past, and large numbers of them have been built. These have included an old-style TRF tuner, an FM tuner, a couple of simple superhets and a couple of more elaborate wide-range tuners, with band-pass aerial input system.

However, the fact remains that the last one of the AM series appeared in May, 1956, or just 3½ years ago. While we have been able to satisfy most inquirers by giving them a copy of this particular back-issue, we felt that the time had arrived for a new design.

But what features should such a tuner have?

It is possible to write down such things as high selectivity, high gain, wide range, short-wave coverage, band-spread and even provision for FM. The only trouble is that a tuner to meet these requirements would be so complex as to be outside the budget or the capacity of most would-be constructors.

To be realistic, only local or very strong stations can provide a signal sufficiently above the noise level and "monkey chatter" effects on the crowded broadcast band to warrant playing them through a high fidelity amplifier system. It is, therefore, quite logical to conclude that most amplifier fans simply want a tuner which combines relative simplicity and low cost with good performance on the local stations.

Well, then, why not just a crystal set type of tuner? Or an RF stage-detector combination?

These are perfectly valid suggestions and perfectly practical for some areas. However, there will be other areas where gain and/or selectivity is inadequate or where more aerial is required than is convenient. Something a little more "universal" is really desirable.

The question of FM is a nasty one. Only a single program is available to listeners in the major capitals, and then on an officially "experimental" basis. Furthermore, it is a duplicate of what is already available, though admittedly with poorer quality, from one or other of the AM outlets.

If it were easy to provide for FM along with AM, there would be little problem. But it isn't. To receive the FM program requires a special tuner or, at least, a specially designed composite unit.

Having considered the whole question our suggested design for the "average" listener is, therefore, a quite deliberately conventional one and in line with what we have suggested in the past.

CIRCUIT ARRANGEMENT

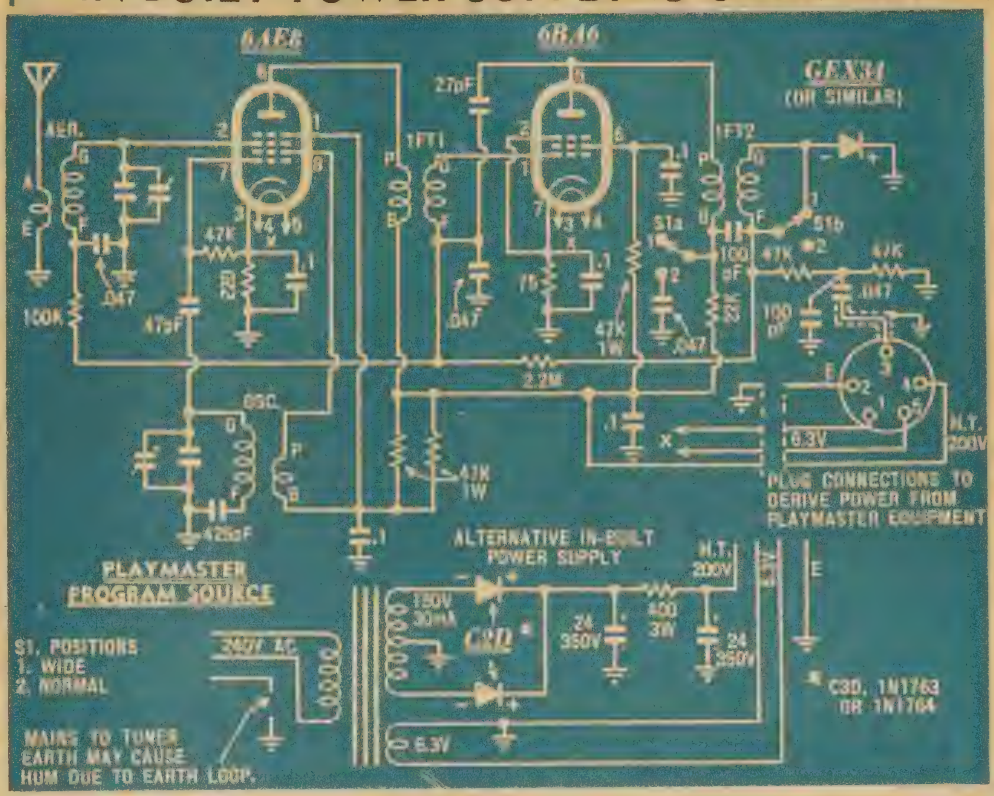
It is basically a 2-valve superhet tuner involving frequency changer, IF amplifier and diode detector. Operating under normal conditions, it handles and behaves just like the tuner in your mantel receiver, bringing in all locals easily on a modest aerial and puttting up a reasonable performance on country and inter-

ate stations, if you
ed it a little more
nerously with sig-
l.
However, a two-
sition switch is pro-
ded which cuts out
e last IF trans-
rmer, and, by re-
ucing selectivity as a
sult, lets through a
eater proportion of
e high frequency
ebands. By the time
ur hi-fi amplifier
ds the bass in its
oper proportion, the
sult sounds very
tisfying indeed.
We gave a good
al of thought also
the mechanical
nstruction. A few
ars ago, building a
ner meant starting
ith a big dial, which
timately became the
ature of the cabinet
ork. The shape and
ze of the chassis be-
nd the dial didn't
atter a great deal.
Now the empnasis
all the other way,
least in high fidelity
mplifier installations.
ide of place goes to
e control unit, with
e tuner (if at all)
esent but not ob-
sive.
One or two of our
dvertisers were quite
lamant in their re-
arks: "If you make
tuner, for Heaven's sake put it in the
me box as your control unit!
"No more fancy dials!"
But some sort of a dial is still neces-
ry, of course, and the choice isn't a
ry wide one. One or two dials which
ve "modest" glasses also have "works"
hind the glass far too bulky to fit into
ything like a control box.
The front-of-panel dials, commonly
ed on transistor portables, just don't
mbine well with the gold-inset knobs
rrently preferred for control units.
hat is more, the lack of vernier action
ay be disconcerting in a domestic in-
llation.

AR RADIO DIAL

This brings us back, almost automatic-
y, to the car-radio type of dial, type
SL48. Even so, it is not ideal. While
e "works" are about the right size,
e glass is a trifle small for the purpose.
so, the chrome-plated escutcheon and
e closely spaced knobs belong much
ore to a car than a lounge room.
However, we feel that our solution to
e problem will have the necessary
peal. It involves discarding the
rome-plated escutcheon altogether and
ng, instead, an engraved or enamelled
nel, similar to that already sold for
e latest type of control unit.
This has a suitably lined cutout,
ough which the illuminated station
ss is visible.
The tuning knob occupies its normal
ndition—almost! By re-drilling and
tting the back plate, the tuning spindle
n be moved away from the dial scale
fficient to achieve reasonable balance.

IN-BUILT POWER SUPPLY IS OPTIONAL



The tuner may be built with or without its own power supply. Where powered from the main amplifier, HT voltage without signal should be adjusted to 200, by varying the supply resistor.

A second knob, controlling the selectivity and placed at the other end of the panel, preserves the general styling and is favourably placed electrically.

And we haven't suggested the obvious name of "Broadcast Tuner," which is about as prosaic a term as one could imagine. If manufacturers follow our suggestion, your label will be branded "Program Source," in line with the overseas trend—or fad, whichever way you look at it!

However, the net result should be quite pleasing.

Finally, there is the question of a power supply. A tuner like this requires something like 200 volts at 15 to 20 milliamps, as well as the energy for the heaters and dial lamp.

Most of the Playmaster amplifiers have been designed for ultimate use with a tuner, for which reason a margin has been allowed in the power transformer rating. However, where the transformer specifications have been varied or where the margin has not been allowed in the first place, the tuner may have to carry its own supply.

POWER SUPPLY

In this new design, we have provided for both situations. If the main amplifier supply can carry the extra load, it is simply a matter of running the appropriate supply leads to the tuner—earth (or B-minus), B-plus and two for the heaters. We shall say more later about the details of these connections.

If the main power supply cannot carry the extra load, there is room in the control box metalwork, which we have used, for the necessary components. They include a small 150-volt 30-milliamp power transformer, two selenium or silicon rectifiers, two electrolytics and a resistor. These provide the necessary heater and high tension supply.

So much for generalities. Now for the details of construction.

As we mentioned earlier, the new tuner is built into a metal box matching those specified for our latest control units. We anticipate that suitably modified boxes and chassis will be made available but, if not, there is no special reason why an existing control unit box should not be used, with a few extra holes drilled, and fitted with a suitable sub-chassis and front panel.

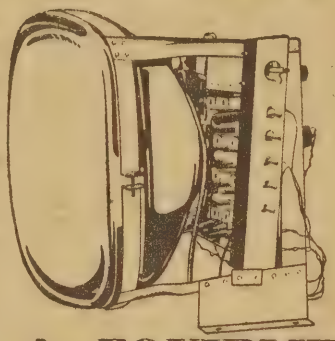
FEW MODIFICATIONS

With a unit of this type one might expect a number of modifications to standard components in order to accommodate them in the available space. However, we have kept these to a minimum and only one proved necessary, namely to the dial drive spindle. This item was simply shifted from the normal positon it occupies on the dial backing plate to the extreme edge of the plate, a distance of about a quarter of an inch.

The method we adopted was simply to extend the existing hole with a round file to form a parallel-sided slot to the edge of the backing plate. Next we drilled two new holes for the spindle mounting screws, so that the spindle could pass through the appropriate hole in the front panel.

The height of several components is critical and must be adhered to strictly,

COMPLETE TV CHASSIS £109-16-8



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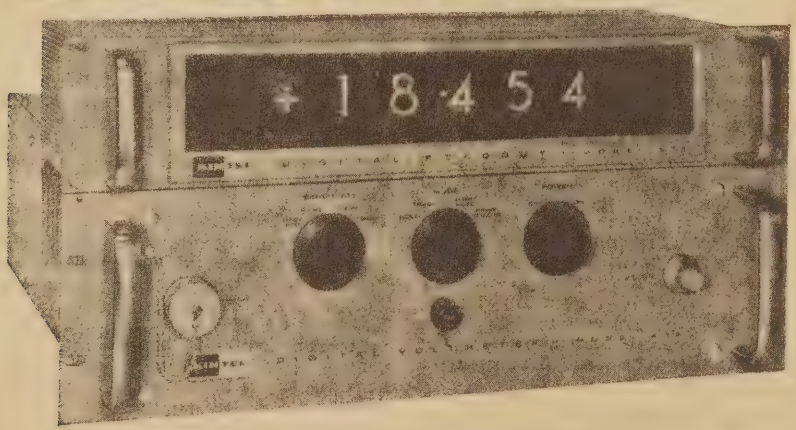

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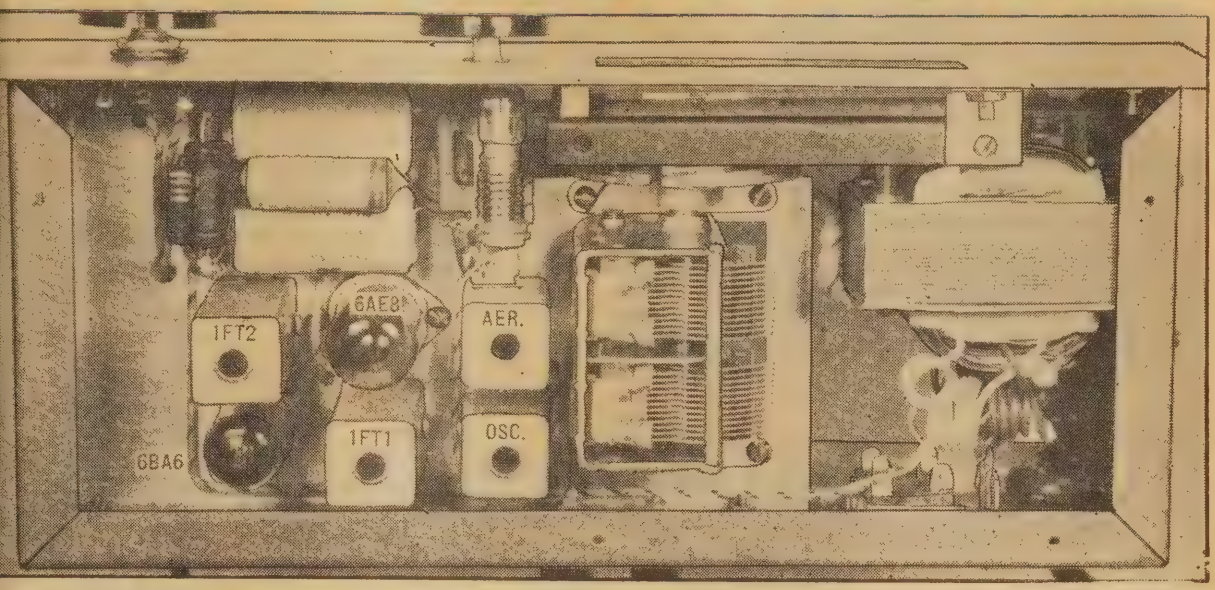
THIS TOP VIEW SHOWS ALL MAJOR COMPONENTS



Looking in the top of the tuner box, with the cover removed. Our final chassis blueprint will allow a little more space between the coils and IF transformers. Note the filter components towards the top left, just near the selectivity switch. The rectifiers are just visible at the bottom right.

clearance is to be maintained. These clude the aerial and oscillator coils nd the IF transformers. We used Q-lus components; other brands would do s well, provided the maximum seated eight does not exceed 2 1/8 inches.

Two other components are critical in eir dimensions, namely the two trim-ers. These should be the smallest and e flattest available. We used the Jabel pe, but there may be others equally itable.

No trouble should be experienced with e valves or their sockets. The latter ay be either the type for mounting be-w or above the chassis and, either way. ere should be adequate clearance un-erneath.

The gang is a standard two-gang Rob-n, no other type being suitable. It is a maximum capacity of 415 pF and mounted upright by means of the ounting feet supplied.

MOUNTING BRACKETS

The dial mechanism is mounted by eans of the mounting brackets at the ttom of the dial. The right-hand one attached to the sub-chassis by means a long screw and a spacer. The left-nd one is attached to the side of the x in the same manner. Care should taken with the length of the spacers allow the dial to be aligned correctly th respect to the cut-out of the front nel.

For added rigidity the top section of e dial backing plate is attached to the nt panel by means of a bracket bent from scrap aluminium.

The dial drum normally comes attach-to the back plate by a centre screw. hen fitting the drum to the gang ndle, this screw must be removed so t the drum may assume the required sition. A bush will also be required build up the gang spindle to fit neatly o the dial drum.

The component layout allows minimum lead lengths to be achieved.

Referring to the overhead view of the unit, you will observe the oscillator and aerial coils to the left of the tuning capacitor. The aerial coil is towards the front of the unit while the oscillator coil is towards the rear

To the left of the oscillator coil is the first IF transformer, followed by the IF amplifier valve. To the left of the aerial coil is the converter valve followed by the second IF transformer

Towards the front of the unit and located between the switch and the dial you will observe a number of components that are usually located under the chassis. This may be a little unconventional, but there is a good deal more room for them in the position suggested than elsewhere

The components thus mounted consist of the HT filter capacitors, the HT filter resistor, the HT paper bypass capacitor and the oscillator supply dropping resistors. The first three components will be required only if an in-built power supply

PARTS LIST

TUNER

- 1 Latest style control unit box.
- 1 Sub-chassis.
- 1 2-gang tuning capacitor (Roblan).
- 1 MSL/48 dial.
- 1 Small aerial coil.
- 1 Small oscillator coil.
- 2 Small 455Kc IF's.
- 1 2-pole 2-position switch.
- 2 Trimmer capacitors.
- 1 Noval socket.
- 1 7-pin miniature socket.

VALVES

- 1 6AE8.
- 1 6BA6.
- 1 GEX34 Germanium diode or similar.

CAPACITORS

- 3 .1 mfd 400 volt paper.
- 2 .1 mfd 100 volt paper or ceramic.
- 1 .047 mfd 400 volt paper.
- 2 .047 mfd 100 volt paper or ceramic.
- 1 425 pf mica, 5 p.c. (padder).
- 2 100 pf ceramic.
- 1 47 pf ceramic.
- 1 25 pf ceramic.

RESISTORS

- 3 47K 1 watt.
- 1 2.2 meg. ½ watt.
- 1 100K ½ watt.
- 3 47K ½ watt.
- 1 22K ½ watt.
- 1 220 ohm ½ watt.
- 1 75 ohm ½ watt.

SUNDRIES

1 5-pin plug and cover, 2 knobs, 2 5-lug strips, 1 2-lug strip, lengths of coaxial cable, hookup wire, tinned copper wire, spaghetti sleeving, 1 dial lamp, 2 terminals, solder lugs and solder, 2 spacers for dial mounting, screws and nuts

POWER SUPPLY

- 1 Power transformer, PF619 or similar.
- 2 C2D selenium rectifiers. (Also suitable C3D IN1763, IN1764 etc.)
- 2 24 mfd 350 volt electros.
- 1 400 ohm 3 watt resistor.
- 1 3-lug strip.
- 1 length of power flex and 3-pin mains plug.

all transistor circuit

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48 gns. *(includes tapes and microphone)*

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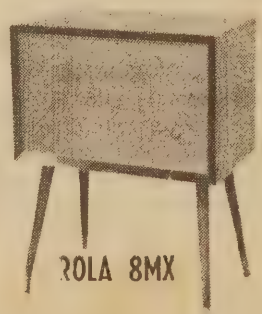

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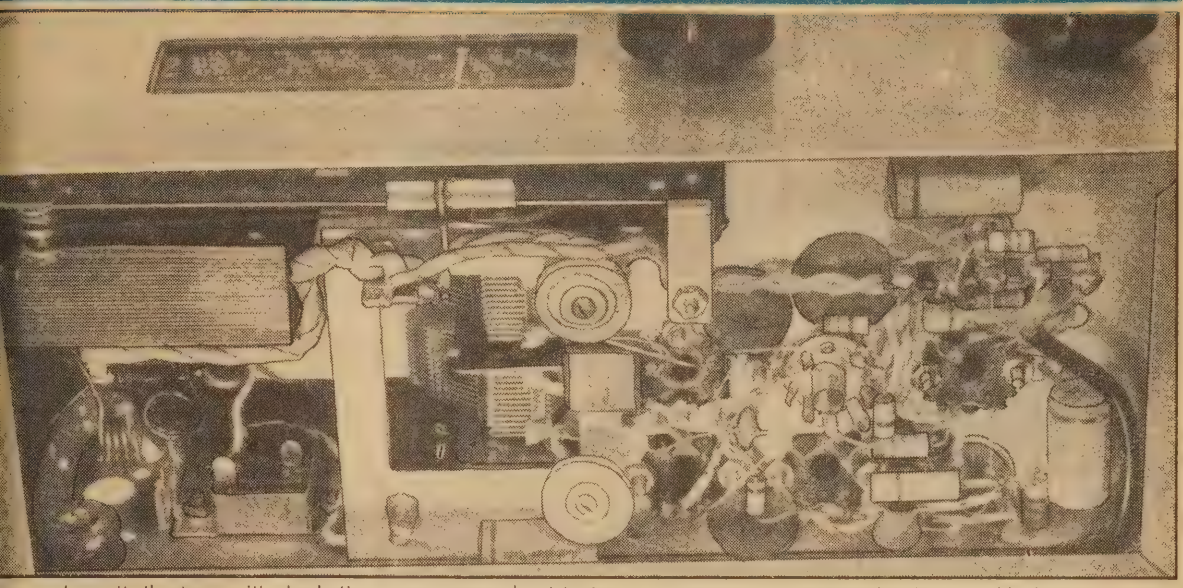
WIRING OF NEW TUNER IS READILY ACCESSABLE



ing underneath the tuner with the bottom cover removed. All wiring and components are immediately accessible for adjustment or service. Enamelled or anodised label fits in front of metal panel.

sed.

he under-chassis wiring layout ild present no difficulty, particularly the currently available miniature ponents. Most of the wiring and ponents can be suspended from t to point. We used tinned copper for the connecting links, mainly rigidity and neatness, but hookup may be used, if you prefer it.

E SMALL COMPONENTS

is wise to use the smallest avail- components to avoid crowding. Re- rs are half-watt types where pos- , the exception being the oscillator dropping resistors and the IF screen pping resistor; these should be one- t types. 100 volt paper or ceramic acitors may be used as cathode and C bypasses but those bypassing HT its will need to be 350 or 400-volt s.

Correct orientation of the coils, IFs valve sockets is essential in the in- sts of stability and to preserve the ness of the layout.

ooking at the under-chassis view, the llator coil is toward the rear of the near the oscillator section of the g and its trimmer. The P and B pins the rear while the G and F pins the aerial coil.

he aerial and earth pins on the aerial face the gang while the G and F face the converter valve socket dir- y to the right. The converter socket o oriented that the gap in the pins pointed almost directly at the front inting bolt of the aerial coil.

longside the converter socket we the first IF transformer which has pins G and F facing the rear, while nd B face the converter socket.

o the right of the first IF trans- ner is the IF amplifier valve socket. socket is oriented so as to place 1 in direct line with pin G on the IF transformer while pin 5 is in dir- line with pin P on the second IF sformer.

front of the IF amplifier valve et is the second IF transformer, the P and B pins of which face the IF valve socket, while the G and F pins face the front of the unit and the five-lug terminal strip.

This five-lug strip provides anchor points for the components in the diode circuit. The audio as well as the AVC take off points are located on this strip.

Leads to the selectivity switch, which is in the upper right-hand corner, are not unduly long. The lower section of the switch, that is the section protruding through the cutout in the chassis, is used to remove the .047 bypass capacitor from circuit thus allowing the 22K resistor to act as a plate load in the wide-band position.

SWITCH WIRING

The upper section of the switch which is above the chassis, is used to short out the secondary winding of the second IF transformer, leaving the diode load only in circuit. The leads to this section from the G and F pins pass through a hole in the chassis, located near the IF transformer.

With any tuner, where a wide response is required, it is fatal to allow any degree of regeneration. Even a small amount, much less than is needed to bring about oscillation, may make the system unduly selective. All the normal precautions should be taken to avoid this condition.

However, it is often difficult to be perfectly sure that such a condition does not exist and we decided to add a simple neutralising circuit. This is a good thing in principle and only involves a single component, a 27 pF capacitor, connected from the plate of the IF amplifier valve to the F pin on the first IF transformer.

The value of this capacitor is not particularly critical but, if added subsequently to a completed tuner, it will call for realignment.

When assembling the major components on the sub-chasis, it would be wise to do so prior to mounting the sub-chassis within the box. However, the wiring may be either completed within the box or out of the box as personal taste dictates. Either method is feasible and equally convenient.

After fastening the sub-chassis in the box, the next step is to mount the dial, observing the precautions mentioned earlier regarding its position with respect to the dial cutout on the front panel.

The tuner may be used with any of the Playmaster series of amplifiers and Control Units and, for that matter, with any other amplifier if the supply voltage and the interconnecting plugs and sockets are modified to suit.

Even with some of the Playmaster Amplifiers it may be necessary to adjust the HT voltage which should not exceed 200 volts with no signal. This may be accomplished by providing and suitably adjusting a series dropping resistor either on the main amplifier or, within the tuner.

When used in this fashion, the heaters within the tuner must not be earthed at any point since this would normally have been taken care of in the main amplifier.

The heater supply leads should be floating and routed through the Control Unit in the usual manner. A five-pin plug will enable the tuner to be coupled to the five-pin socket normally found on Playmaster Control Units.

POWER SUPPLY

Most amplifiers will have a power supply with an adequate rating to supply the tuner as well. In a borderline case or where an auxiliary power supply is preferred, it may be built into the tuner box with comparative ease.

Adequate space has been provided in the design of this unit for a simple supply consisting of a power transformer, two selenium (or silicon) rectifiers and a simple filter comprising two electrolytic capacitors and a filter resistor.

The power transformer is rated at 150 volts per side at 30mA and measures 2⅝ x 2¼ x 2in overall. There are other transformers with identical ratings but physically larger. Although these will just fit in, they produce quite needless crowding at this end of the box.

Mount the transformer to the side

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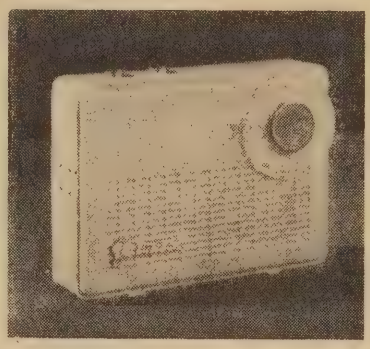

MIDGET CRYSTAL SETS

Chieftain (as illustrated) with headphone, aerial and earth leads, etc., in Ivory bakelite case 3 3/8in long x 2½in high x 1in deep. Provision for extra headphones. Using germanium detector this set is reliable and efficient with good sensitivity and selectivity **Price only £3/18/ each.**

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13. **Filament Transformers.** 2.5 volt at 1.75 amp. with 5000 volts insulation. (Ref. No 80.) **Price 17/ each.**
14. **Tuner Coupling** I.F. Frequency 33.5 Mcs for TV sets. (Ref. No. 101.) **7/6 each.**
15. **Kit of IF Transformers** for Video Strip consisting of 5 IF's as used in RCS IF strips. (Ref. No. 210.) **Price only 29/6.**
16. **Kit of IF Transformers** for 5.5 Mc sound IF strip. Ref. No. 211. **Price only 20/** set. 2 IF's and Ratio Detector.
17. **5.5 Mc Trap** in Can (Ref. No 209.) **4/ each.**
18. **E.H.T. Transformers** for 3000 Volts HT supply to operate VCR97 or similar tube Circuit enclosed with each (Ref. No 220.) **Price only 17/.**
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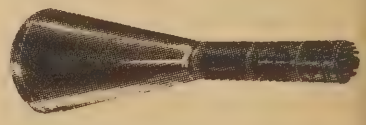
8 x 5 x 2½ ..	10/	17 x 8 x 3	22/6
10 x 6 x 2½ ..	12/	17 x 10 x 3	25/6
11 x 8 x 2½ ..	14/	17 x 12 x 3	26/6

CATHODE RAY TUBES AND RADIO VALVES



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Type EL50 Power Output Penode 6.3 filament with P type base, 2 of these valves in class B will give 80 watts output. This is also an excellent single end tube which will give in Class A about 8 watts output and high gain. Well worth 30/. **Our price 7/6.**

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26	5/	49	5/	B409	5/	1F5G	5/
30	5/	50	5/	B605	5/	FC13	9/
27	5/	VR54	10/	CF1, SP13 .. .	7/6	PM254	5/
31	5/	7C7	3/6	VR91	5/	PM1	5/
32	5/	58	7/6	VR130	2/6	PM12A	5/
33	5/	77	5/	2A3	12/6	NR74	7/
34	5/	84-6Z4	7/6	VT75A	3/6	ARP12	5/
35	5/	85	5/	6R7	7/6	FC2A	5/
36	5/	506	5/	6R7G	6/6	KC3	7/6
37	5/	A109	5/	KDD1	5/	6SF7	8/6
38	6/	A442	5/				

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panel of the box, keeping it as close as possible to the dial. Adequate space then remains for mounting the rectifiers and the tag strip on which terminate the incoming AC leads and the transformer primary leads. The tag strip may be anchored by one of the rectifier mounting screws and nuts.

The heater supply leads from the transformer are anchored at a two-lug strip held by the gang mounting screws nearest the power transformer.

One of the lugs is earthy and this serves to earth one side of the heater line. Leads to the heaters and the dial lamp branch off from this tag strip.

Either silicon or selenium rectifiers may be used in this supply, the silicon types being slightly more expensive but giving equivalent results. Suitable alternatives are given on the circuit diagram.

We used the selenium types C2D because of their slight price advantage and the fact that they happened to be on hand.

The selenium rectifiers are chassis mounting types while their silicon counterparts are equipped with pigtails and will need a mounting strip in the same way as resistors and capacitors.

TWO REQUIRED

Single units in either case are capable of only half-wave rectifications and two will be required. The selenium units are equipped with three terminals marked plus, minus and AC. For push-pull operation the AC terminals are not used, the transformer secondary being connected between the two minus terminals.

A positive voltage will be available from each of the positive terminals and these should be joined together to add the current outputs of each rectifier.

All that remains to complete the power supply is to wire the filter components above the chassis and to run a connecting lead to the rectifiers.

A simple resistance capacity filter is quite adequate for this type of work and no hum problems were experienced. Two 24 mfd 350 volt electrolytics give adequate smoothing while the 400 ohm 5-watt resistor serves as a filter resistor and limits the HT voltage to about 200 volts with no signal.

Having completed the wiring and supplied the power, it now remains to align the tuner. The alignment procedure is quite routine and the only point that will bear watching is that the selectivity switch is in the normal position during alignment.

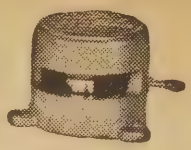
FROM THE EDITOR — IN EUROPE

(Continued from Page 31)

sports Stadium could be shown. If there were a Summit conference that, too, would be of interest," he said.

The main task was to get programs that would be popular in both Russia and England. The British people, for example, might be interested in seeing how new laws were passed in Russia, and how a new government was formed.

Comparing British and Russian television programs, Mr Ivanov said he did not like the great number of westerns which were shown here. So many people were killed that human life seemed to be valued at the price of a cartridge. They had no similar programs in Russia, but instead had historical films and programs which showed how the virgin lands of Russia were being developed.



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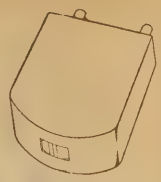

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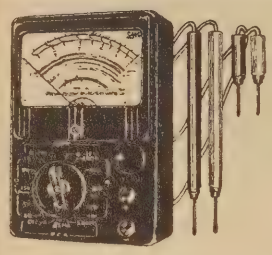

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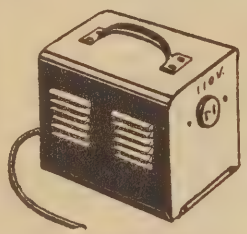

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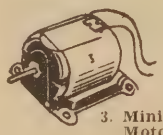

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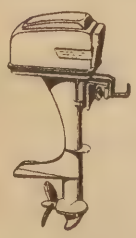

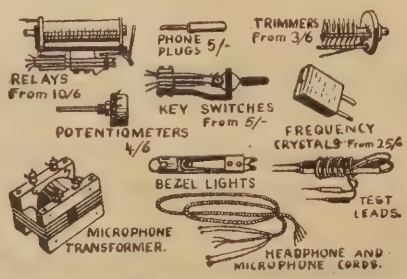

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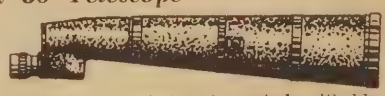

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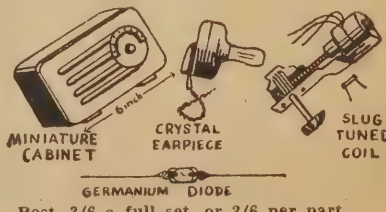

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CHECKING AUDIO POWER OUTPUT

Here is a brief discussion on the "why" and "how" of power output measurements for amplifiers and a description of a simple resistive load box to replace the voice coil in such tests. In conjunction with your audio generator, multimeter or VTVM and CRO it completes the set-up for this very important test.

By PHILIP WATSON

ONE of the first tests which should be carried out on any new amplifier is a power output check. This will help to establish more certainly than anything else whether the amplifier as a whole, and particularly the output stage, is operating as was intended. Failure to reach the specified figure is a clear indication that operating conditions need checking or modifying before proceeding with any other tests.

Yet it is surprising how seldom this test is made or, if it is made, how seldom it achieves a useful degree of accuracy due to the manner in which it is conducted.

This is surprising, because it is a relatively simple test, capable of good accuracy and requiring little in the way of equipment not normally accessible to a great many audio enthusiasts. In fact, the main requirement is simply that it be conducted correctly.

There are two ways in which this job may be approached and both have their place in the scheme of things. One measures power developed in the primary circuit of the output transformer and the other the power available in the secondary and which eventually reaches the voice coil of the loudspeaker.

LOAD RESISTOR

Both involve feeding the audio power into a load resistor of the appropriate value, measuring the audio volts developed across it at the overload point and, from the figures, calculating the audio power output.

The measurement of primary power is useful mainly in developmental work, as when it might be desired to establish the correct load for a set of unpublished operating conditions. Its main advantage is that it is largely independent of losses or variables in the output transformer which might otherwise confuse the issue.

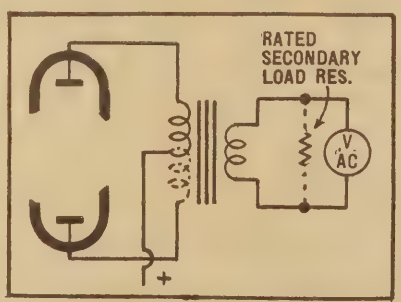
Secondary power is a more useful figure when we wish to know just how many watts are available to drive the speaker or other device. It is rather less decisive as a measure of the output stage operating conditions. However, if a reasonable estimate can be made concerning the output transformer losses it nevertheless provides a very useful all-round figure-of-merit for the amplifier's performance.

It is most useful where, a design having been worked out and accepted, it is desired to establish that any individual amplifier made to it does in fact approach the output claimed and is therefore unlikely to contain any major faults.

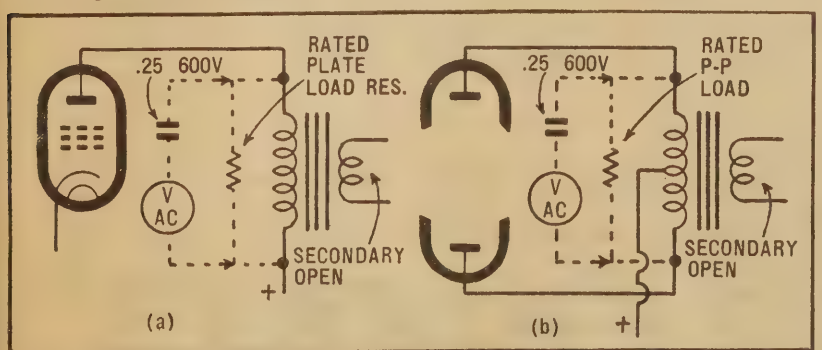
POWER RATING

When an amplifier is rated by its designer as a 10-watt type this may mean, unless expressly stated to the contrary, that it is capable of developing 10 watts in the transformer primary circuit. A secondary winding measurement may reveal no more than 7.5 watts, or as much as nine watts, depending on the efficiency of the output transformer and the accuracy of the measurements.

In general, the better class output transformers have efficiencies between 80 and 90 per cent, so that the aforementioned range of figures would be quite reasonable. Considered in the light of what might reasonably be expected from a particular transformer it would give quite an accurate picture of the amplifier's capabilities.



This diagram shows the set-up for measuring audio power from the secondary of the output transformer.



The set-up for measuring audio power on the primary side of an output transformer (a) single-ended and (b) push-pull. If used on a low voltage scale, the shunting effect of the meter on the load must be allowed for, as explained in the text.

REASONABLE ORDER

The important point is to establish that the output is of a reasonable order rather than, say, only two or three watts or something equally silly.

A check of this nature is even more important where high power P.A. amplifiers are concerned, due to the virtual impossibility of running them "full bore" into a speaker load on the bench—or of assessing anything worthwhile from such a test if it were possible.

Regardless of whether we intend to measure primary or secondary power, four major items of test equipment are required: An audio generator to provide a test signal; a C.R.O. to monitor the output waveform and indicate the onset of overload; some form of resistive load to replace the less accurate speaker; an "output meter" to measure the voltage developed across it.

The requirements of the test signal are not unduly stringent. A frequency of 1,000 cps is usually chosen, and the waveform should be a reasonably good sine wave. If a regular audio oscillator is not available the audio output from a conventional signal generator may be used. This usually is about 400 cps and anything between this figure and, say, 1,500 cps should be quite satisfactory.

TYPE OF WAVEFORM

Most audio oscillators, even in simple form, are capable of generating a reasonably good waveform and there seems little point in worrying over a few per cent distortion for a job like this. However, anything exhibiting either an obvious peakiness or squared-wave characteristics should be avoided.

In an emergency, it might even be possible to utilise a 50 cps supply from a power transformer, but there are reservations to this suggestion. First, the output transformer would have to be capable of handling the maximum power output without serious distortion at this frequency. The restriction automatically limits this to one of the better-quality types with good low frequency response. "P.A." or "medium fidelity" types are unlikely to be good enough

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18. Portagram (A.C.) 4
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20. Transistor 2
21. Transistor 3
22. Transistor 4
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and may overload at a much lower power level than would apply higher up in the audio register.

Secondly, the effect of this frequency on the voltmeter must be considered. In particular, any DC blocking capacitor which may have to be used is likely to have considerable impedance at this frequency and could easily render the readings meaningless. If such a capacitor must be used, at this frequency, care should be taken to see that it is large enough to avoid this complication.

(A DC blocking capacitor will be needed whenever measurements are to be made on the primary side of the transformer. Even if the meter is connected directly across the transformer primary, there may be a small DC voltage present, due to the resistance of the primary winding. There is no such problem when measurements are made in secondary circuit and the normal AC ranges may then be used.)

CRO NOT CRITICAL

Not a great deal need be said about the CRO, since almost any instrument worthy of the name should be suitable. Its job is to indicate the exact overload point of the amplifier, as shown by pronounced flattening of one or both halves of the sine wave. While it may be possible to do this by temporarily substituting the loudspeaker and checking for audible distortion this leaves a great deal to chance.

It takes a keen ear to detect the first onset of distortion, plus the fact that the speaker load may not be exactly equal to the resistive load, and the overload point may occur at slightly different level as a result.

While such an arrangement may be justified in an emergency, a CRO is the only really satisfactory way to reveal overload. Connected across the load, or between the "hot" side and chassis, it will reveal the first signs of overload or clipping, and indicate by exactly how much the gain needs to be reduced for a clean waveform.

A resistive load is necessary to replace the speaker voice coil, because the impedance of the latter is very much a "nominal" figure. The factors contributing to it are so varied and their relationship so complex that a variation of two or three-to-one is not unusual at ordinary operating frequencies.

PRIMARY LOADING

Where primary power is to be measured, this resistor, which should equal the required primary load, is connected directly across the output transformer primary and all load removed from the secondary winding. So connected, the output transformer is functioning purely as a choke through which DC flows to the plate (or plates).

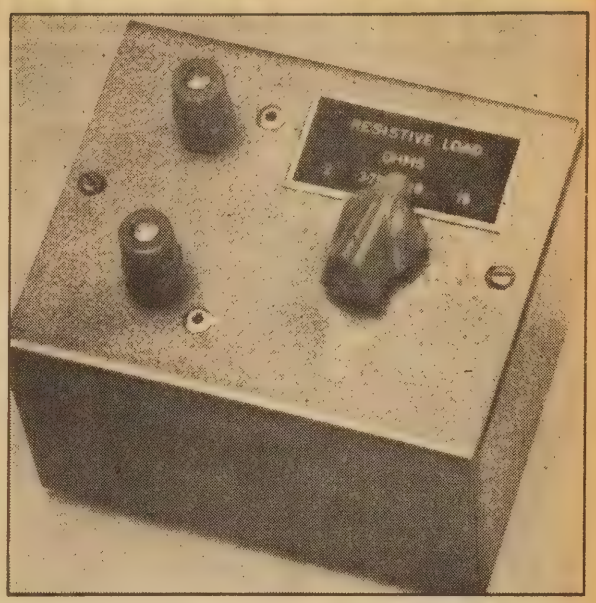
The amplifier is then driven up to the overload point, backed off slightly, and the AC voltage developed across the load resistor measured as accurately as possible. From voltage and resistance the power may be calculated according to the following formula:

$$W = \frac{E^2}{R}$$

Where:

W is the power in watts.

A HANDY LOAD RESISTANCE BOX



This handy little metal box contains resistors which can be switched to give values of 2, 3.75, 8 and 15 ohms. As indicated by the circuit diagram overleaf, four resistors are required, preferably heavy-duty types.

☆

E is the RMS audio output volts, and

R is the load resistance in ohms.

A point to watch here is the possible effect of the meter resistance on the amplifier load, particularly when moderate amounts of power only are involved and where the meter may be used on a lower scale.

For example, a 10,000 ohm load resistor shunted by a 50,000 ohm meter (1,000 ohms/volt, 50 volt scale) will be reduced to 8,300 ohms approx.; a significant error.

To produce a true 10,000 ohm load in such circumstances it would be necessary to start with a resistor of about 12,500 ohms.

SECONDARY CIRCUIT

If secondary power is to be measured, a resistive load equal to the nominal voice coil impedance must be provided and substituted for the voice coil. As before, the AC voltage developed across this is measured and used in the previously stated formula to determine the power.

In this case it is unlikely that the voltmeter resistance will have any significant effect on the load.

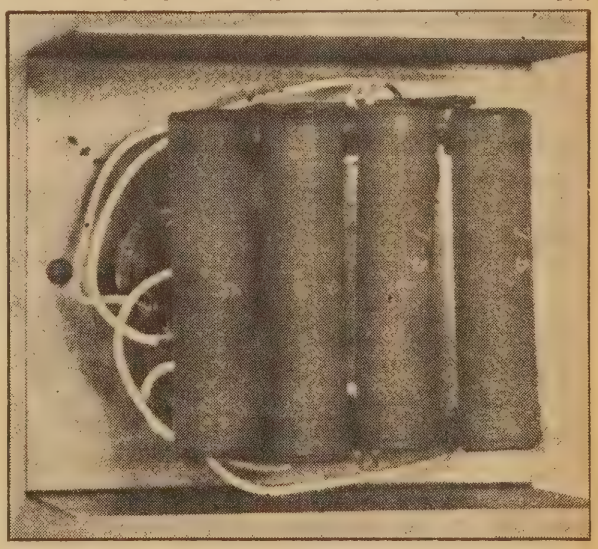
As already implied, the meter need be nothing more than a conventional multimeter equipped with "AC" and "O/P" ranges, provided due allowance is made for possible loading effects as already stated. However, accuracy is important, a fact which may be better appreciated when it is recalled that power formula requires the square of the voltage, meaning that any error will be magnified.

Thus a meter which gives a reading of 9 volts instead of 10 (a 10 per cent error) will result in a figure of 81 being found in the formula in place of the correct figure of 100—an error of 19 per cent!

The combined effect of low frequencies and conventional DC blocking capacitors on meter accuracy has been mentioned already, but errors also may be encountered above about 5 Kc in some ordinary multimeters.

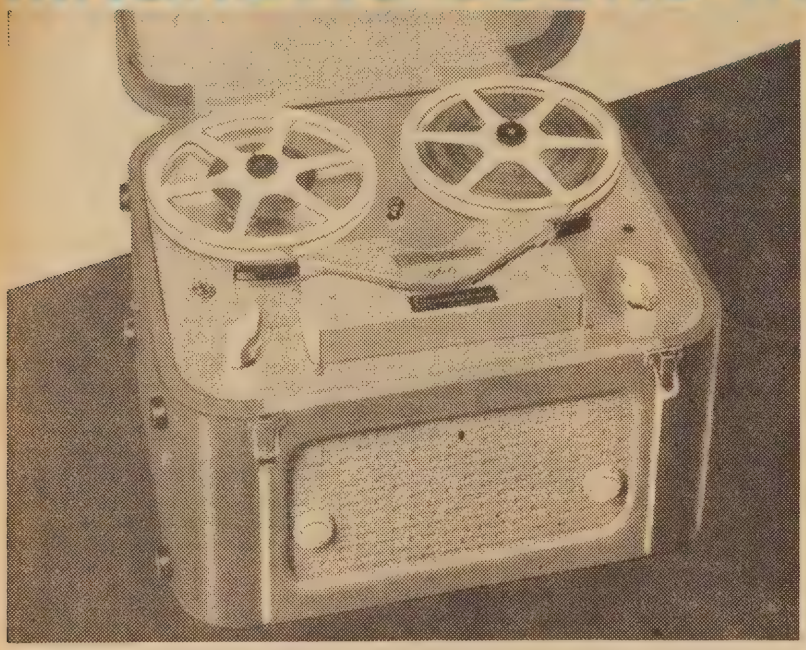
These may be due to the limitations of some older type rectifiers and to the distributed capacitance within the meter wiring. More particularly where frequency response curves are being taken, the possible effect of these limitations should be kept in mind but they also apply in circumstances involving use of high frequencies for power measurements.

Fairly obviously, these remarks apply



An underneath view of the resistance load box illustrated above. The switch is just visible.

MAGNETIC SOUND INDUSTRIES



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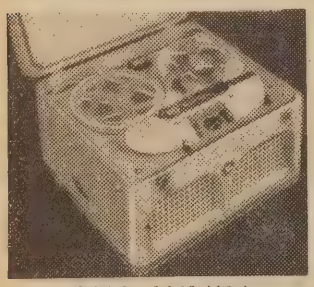

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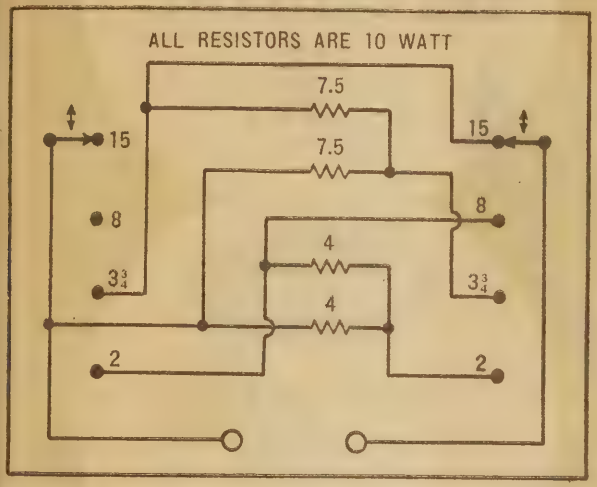
mainly to primary, or high impedance measurements.

Coming to the more practical side, there is the matter of providing suitable load resistors for all the possible primary and secondary values likely to be encountered in practice, remembering that they may have to dissipate 20 watts or more on occasions.

Fortunately, as far as voice coil impedances are concerned, things are pretty well standardised these days and three or four values will cover almost all likely requirements. This being so, there is a good case for collecting a set of suitable resistors and making them up into a complete "resistive load" box.



Shown above is the circuit arrangement of the resistance load box pictured on the previous page. The switch wiring is tricky but performs the functions required of it.

Such an arrangement has several advantages. The resistors will be protected from damage, will not be "lost" when most needed and, being easy to use, will minimise the temptation to by-pass this test, due to the time and trouble involved.

The accompanying circuit shows how four resistors, in two readily available values, may be switched to provide the most commonly used voice-coil values: 2, 3.75, 8 and 15 ohms. The switch is a simple two-pole four-position type.

Each resistor is rated at 10 watts continuous and 15 watts intermittent operation and, since two are always used and generally intermittently, a rating between 20 and 25 should be fairly conservative.

COMPONENT PARTS

When we came to collect the necessary bits and pieces to make up such a unit, we approached one of our advertisers for some suitable resistors and a switch. On learning the nature of the project he was able to supply, not only these items, but a small metal box in which it could be built, plus the terminals, knob, tag strips, etc., to make a complete kit of parts.

The only thing missing was a label to indicate the switch positions and, with everything else already on hand, it seemed worthwhile to have one etched for the job.

As a result, there is now a complete kit available for those who want it, individual items for those who may want to use existing parts, or a completely assembled and wired unit for those whose time is more precious. They will be handled by the "Jabel" organisation.

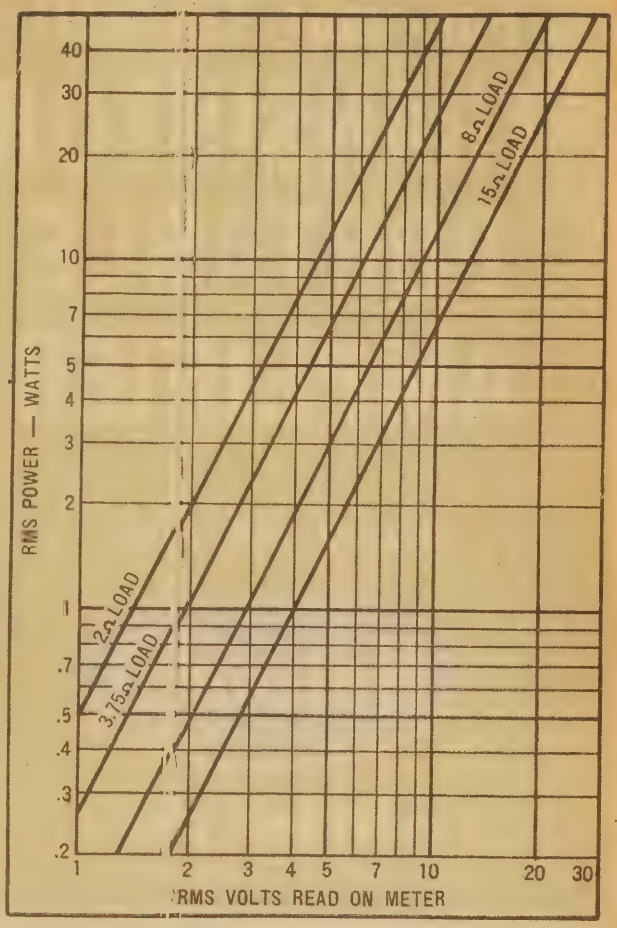
The metal box measures 4in x 3¼in x 2¾in and is quite large enough to house everything comfortably. A good idea of the layout may be obtained from the photograph and is almost self explanatory. Two five-terminal tag strips are mounted close to each side and the resistors are mounted between them and high enough to clear the small switch.

The wiring is quite simple, but most of it should be done before the resistors are mounted, keeping in mind the order in which these are shown in the photograph.

Otherwise there is very little to the construction, but you will find the finished unit a very useful item wherever amplifiers of any kind are to be tested.

OUTPUT POWER v. OUTPUT VOLTS

The graph on the right shows the relationship between audio output volts and audio output power across the four values of secondary load provided by the circuit arrangement below.



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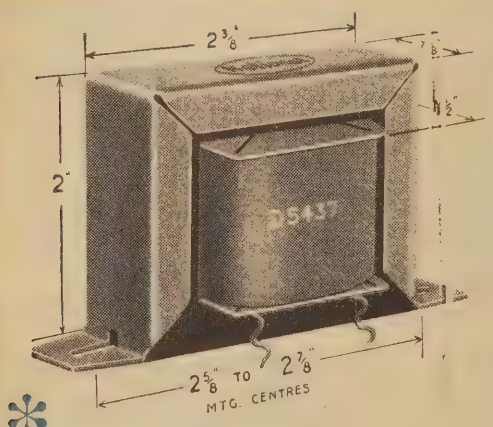

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Secondary 3.52 ohms a side.

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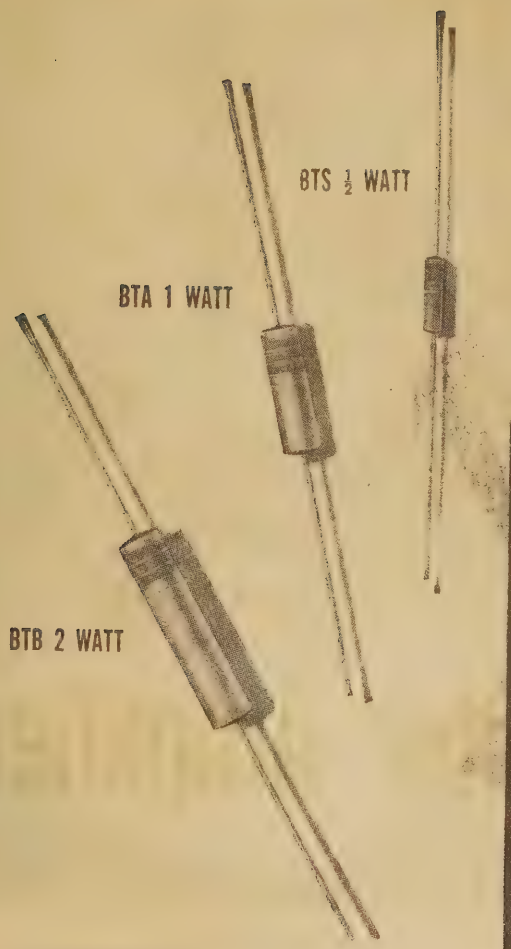

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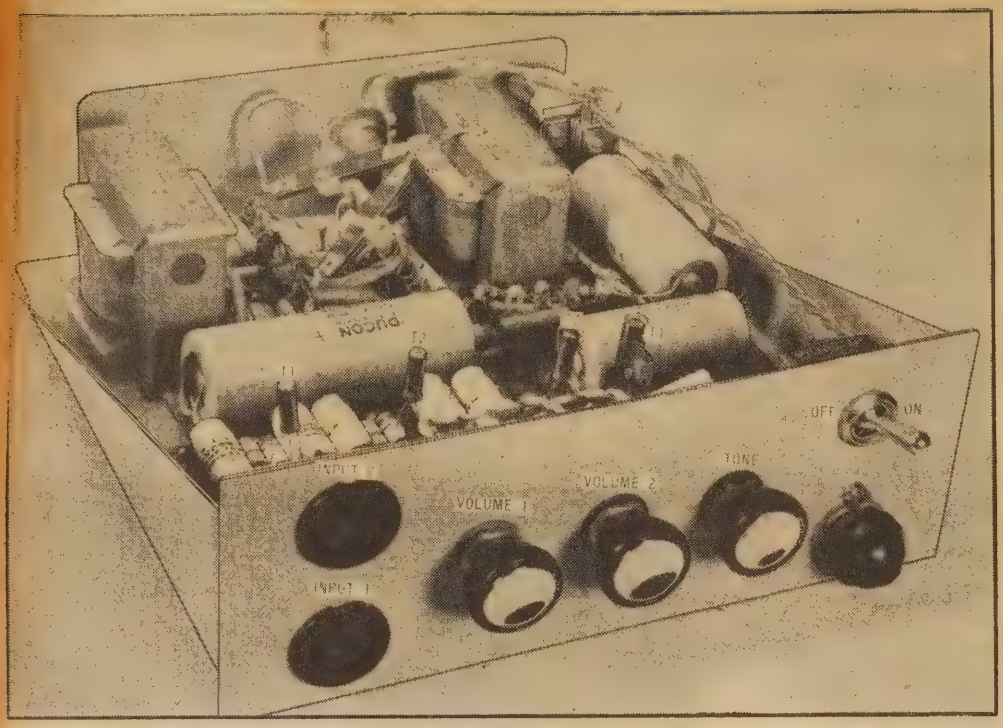


The chassis of our new portable public address amplifier, which has been designed expressly to meet the needs of churches, social groups, etc. It combines high peak power output with portability and economy of battery drain. Controls, input and output sockets of the amplifier are visible in this coded photograph. Baseplate is designed for ease of construction and at the same time offers a large heat sink area with the object of keeping the output transistors cool. A case will be described later, with carrying handle, in which the controls will point vertically upwards. Note that the panel is faced with plastic cloth held by contact adhesive.

10-Watt Transistor Amplifier

Our latest transistor amplifier is the heart of a compact and efficient public address system. Powered by a 12-volt battery, it can deliver better than 10 watts at low distortion. Facilities for moving coil microphones and either crystal or magnetic pickups are provided. Small size notwithstanding, this amplifier will do a man-sized job.

PUBLIC address amplifiers for operation away from power supply mains are normally very similar to A.C. amplifiers except that a vibrator high-tension unit is substituted for the normal high-tension transformer and rectifier valve.

Overall efficiency of the vibrator power supply is about 60 p.c. and, in addition, power has to be found to supply the heaters of the valves. For an amplifier delivering 10 watts it would not be unusual for the total current drain to be 6 amps. from a 12-volt supply, where the output valves are adjusted to operate in class AB1 conditions.

Careful design, plus a class-B output system may reduce the average current drain to a figure around the 4 amp mark.

MODERATE CURRENT

Average current drain for the new transistor amplifier with speech and music is around I ampere, assuming that the gain is adjusted so that the output stage reaches occasional overload on peaks. With no signal input, the current drain is less than 400 mA.

But even this is not the full story. A normal valve amplifier requires at least 30 seconds for the cathodes to reach operating temperature. For occasional announcements at sports meetings, club socials, etc., the heaters usually have to be left running continuously.

Full gain and power output are available from the transistor amplifier virtually instantaneously. It is quite practical to have a power switch, operating a relay if convenient, on the microphone. This switch is placed in the "on" position only when it is desired to make an announcement.

Better still the switch can have a spring return so that it automaticaly reutrns to the off position when pressure is released: in other words a "press-to-talk" system. Average battery drain over a few hours of occasional announcements is then almost negligible.

We did, in fact, consider the proposition of operating the amplifier from dry batteries.

For some users with special requirements it may be worthwhile. Two 6-volt lantern batteries in series should give a total of about 4 hours provided the operation is intermittent.

by Maurice Findlay

Full-power output will not be available over the entire time, because the internal resistance of the battery causes the terminal voltage to drop on peaks of current, an effect which increases as the battery nears its end of life.

Cost of the lantern batteries is about 8/ each. At 16/ for four hours' operaiton lantern batteries are an expensive power source, though perhaps quite acceptable for certain applications.

MORE ECONOMICAL

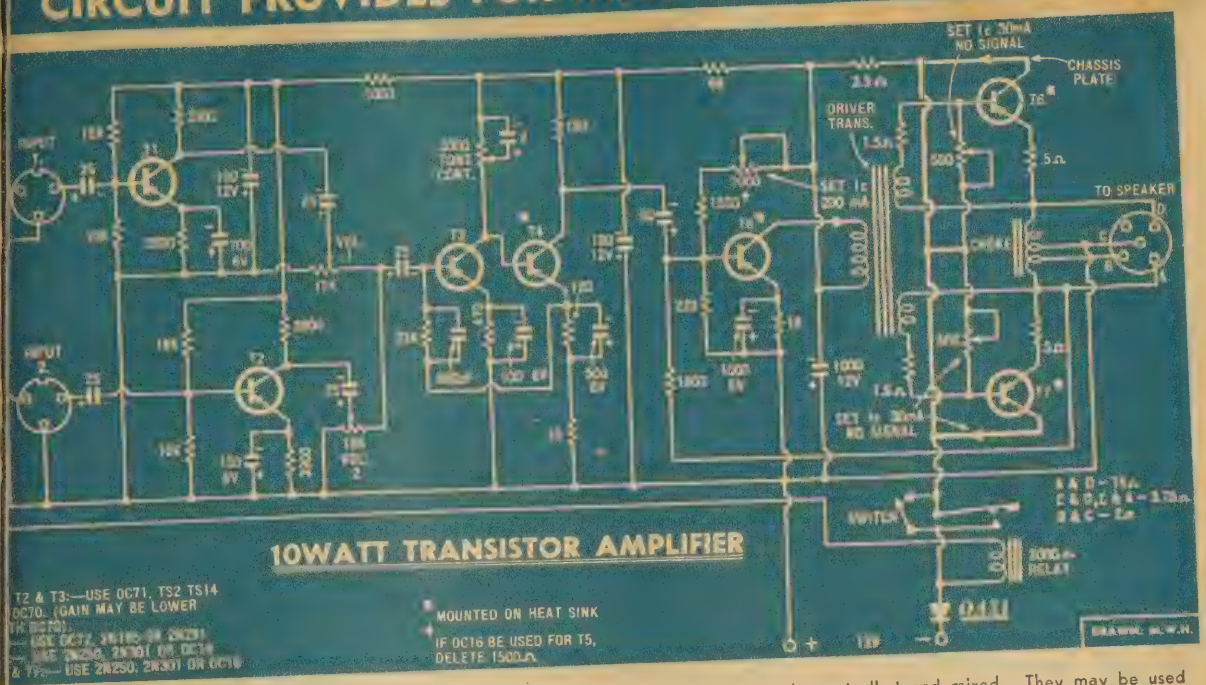
In terms of hours-per-pound the proposition is better if two sets of lantern batteries are connected in parallel. Also, the peak-power output is increased because the internal resistance of the batteries is halved. However, this means a capital outlay of 32/ or more to gain the convenience of easy portability.

Accumulators are heavy and present an acid danger, but the total cost of operation of the amplifier over a period is a fraction of that for dry-battery operation.

There will be many cases where the amplifier can conveniently be operated from a car battery for a few hours with negligible effect on the car. Alternatively, if operation well away from a car is required, an accumulator can be borrowed from a car or a garage.

Therefore, our final design does not

CIRCUIT PROVIDES FOR MIC. OR PICKUP INPUT


10WATT TRANSISTOR AMPLIFIER
SET Ic 30mA NO SIGNAL
CHASSIS PLATE
DRIVER TRANS.
TO SPEAKER
SET Ic 250 mA
SET Ic 30mA NO SIGNAL
T2 & T3:—USE OC71, TS2 TS14 OC70. (GAIN MAY BE LOWER
MOUNTED ON HEAT SINK
IF OC16 BE USED FOR T5, DELETE 1500Ω
USE 2N250, 2N301 OR OC16

Here is the complete circuit diagram of the amplifier. The two inputs can be separately controlled and mixed. They may be used directly with dynamic type microphones or with crystal pickups, provided a resistor of 0.22 to 1.0 meg. is wired in series with the active lead. The amplifier may operate continuously or on a push-to-talk basis.

like provision for internal batteries. Power outputs of the order of 10 atts can be obtained readily from wer transistors now available through dio-supply stores.

Since medium-priced 8in and 12in eakers as are likely to be used for blic-address work are not normally ted to handle much more than 5 watts, e available power enables two speak- s to be fully loaded.

Only in special cases will more than vo speakers be required, so that, in ost cases, the 10-watt amplifier and vo speakers will result in a well-pro- ortioned public-address system.

We envisage that most people will use microphone with the amplifier most of ne time. However, the value of the ystem would be very much increased if pickup could also be used and mixed vith the output of the microphone in any esired proportion. This provision has ccordingly been made.

PUBLISHED DESIGN

While we were considering the design of the amplifier in detail, our attention was drawn to a circuit published by Mullard Limited of London in their "Technical Communications."

An excellent feature of this amplifier is that it allows the collectors of both output transistors to be connected to the case without the need for mica washers or other electrical insulating medium.

This makes it easy to obtain good heat transfer between the collectors of the transistors and the heat sink, while simplifying the mounting procedure.

The driver stage transistor collector has to be insulated from earth by a mica washer but it is not necessary to provide such good heat transfer in this case because the transistor is operating at a relatively low heat dissipation.

Although the collectors of the transistors are grounded, the stage actually operates in the common emitter configuration. Drive is applied between base and emitter from a secondary winding of the driver transformer. The load for the output transistors is placed between the emitter and the common supply line. The circuit to the collector is completed through the battery.

It is virtually a common emitter arrangement with the battery and load positions reversed.

In a transistor class B stage, as in the valve equivalent, each amplifier conducts for only half the cycle approx. For low distortion it is necessary to have two transistors operating in push-pull. The idea is that one transistor conducts when the current swings in one direction and the other when current swings in the opposite direction.

Provided the operating conditions for both transistors are carefully adjusted, the two together complete an amplified version of the original waveform.

PARTS LIST

1 Matrix Board, 2 3/8in x 6½in.
1 Chassis and panel (see drawing).
1 Driver transformer (D5437 or similar).
1 Output transformer (D5420 or similar).
1 2000 ohm Relay (single contact).
1 On-Off toggle switch.
2 3-pin sockets (input).
1 5-pin socket (speaker).

TRANSISTORS

(See circuit for alternative types)
3 TS2.
1 2N185 with heat sink.
3 2N250.
1 OA31 Diode.

RESISTORS

2 18000 ohm ½W. 5 p.c.
4 3900 ohm ½W. 5 p.c.
2 10,000 ohm ½W. 5 p.c.
1 1000 ohm ½W. 5 p.c.
1 33,000 ohm ½W. 5 p.c.
1 470 ohm ½W. 5 p.c.
1 120 ohm ½W. 5 p.c.
2 10 ohm ½W. 10 p.c.
1 180 ohm ½W. 5 p.c.
1 1800 ohm ½W. 5 p.c.
1 1500 ohm ½W. 5 p.c.
1 220 ohm ½W. 5 p.c.
1 68 ohm ½W. 5 p.c.
1 3.9 ohm 1W. 5 p.c.
2 1.5 ohm ½W. 5 p.c.
2 .5 ohm ½W. 5 p.c.
1 1000 ohm, adjustable.
2 500 ohm, adjustable.
2 10,000 ohm, low hop on Pot.
1 2000 ohm Pot.

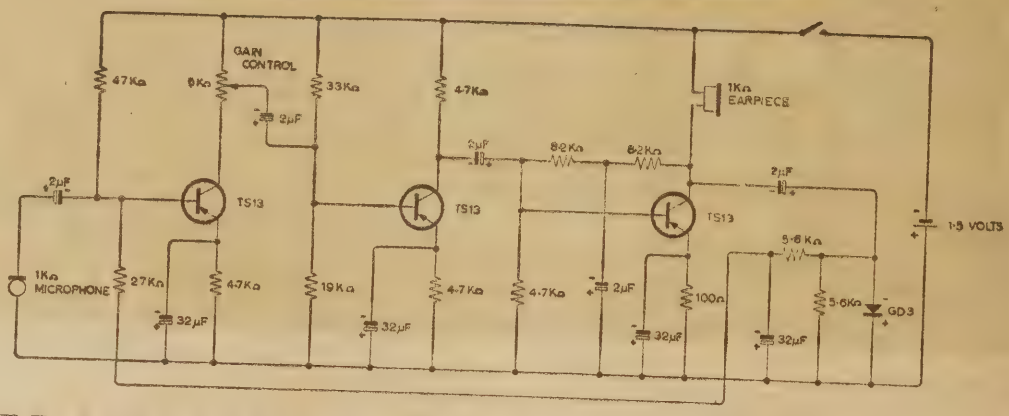
CAPICATORS

5 25 mfd. 12 VW electrolytics.
5 100 mfd. 12 VW electrolytic.
1 50 mfd. 12 VW electrolytic.
1 500 mfd. 12 VW electrolytic.
1 1000 mfd. 6VW electrolytic.
1 1000 mfd. 12VW electrolytic.
1 68 pf ceramic.

SUNDRIES

1 5-tag terminal strip, 1 8-tag terminal strip, 2 7-tag terminal strip, 3 knobs, eyelets, hookup wire, nuts and bolts, solder, solder lugs.

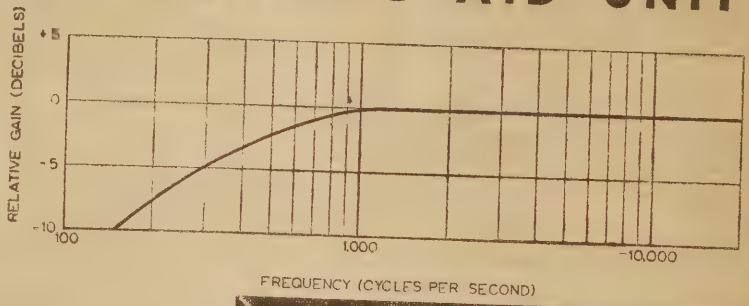
STC SETS THE STANDARD FOR TRANSISTORS



TRANSISTOR HEARING AID UNIT

The circuit diagram above shows a transistor hearing aid unit capable of very good performance, although of simple design.

It is intended for use with an earpiece and microphone of the magnetic type, both of which are readily available. The absence of iron-cored transformers enables the unit to be of very small physical size.



The voltage gain is approximately 45 dB. with a supply voltage of 1.5 volts, which is generally adequate; it can be increased to approximately 54 dB. by using a supply of 3 volts. The current drain at 1.5 volts is 3.5 milliamperes. If even greater gain is required, an additional transistor can be added.

The frequency response of the amplifier itself is shown in the accompanying curve; the response of the entire unit will depend also upon the characteristics of the microphone and earpiece.

The audio frequency output voltage is rectified by means of a germanium diode, filtered and applied to the base of the first transistor to operate as an automatic gain control system.

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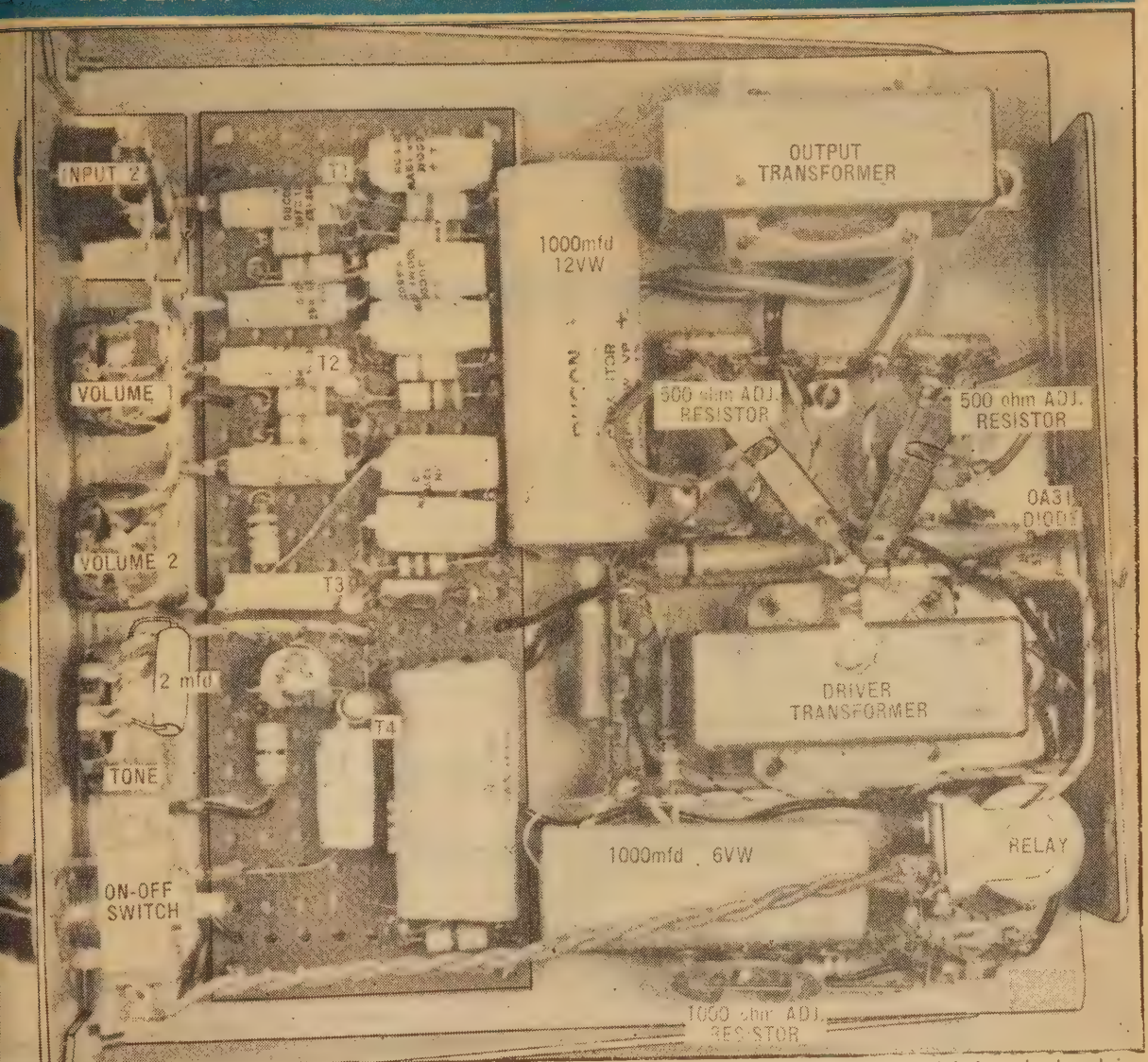
M182D

A PLAN VIEW OF THE NEW AMPLIFIER CHASSIS



Details of the layout and wiring are visible in this photograph. Matrix board wiring should be completed before the board is bolted to the metal baseplate.

In order that the correct drive be applied between the base and emitter of the output transistors, it is necessary that the driver transformers have two separate and insulated secondary windings. This point can be followed more clearly by reference to the circuit.

CLOSE COUPLING

Although the driver transformer secondary windings must be insulated electrically, they should be closely coupled magnetically so that one transistor is able to take up its part of the cycle as soon as the other transistor has ceased conducting.

Transformer engineers do this by bifilar winding the transformer secondary sections which, translated to practical terms, means that the entire secondary is constructed by winding two insulated wires side by side. The wires can be separated outside the transformer and used at different DC levels if desired.

If the driver transformer has to be slightly more complicated in order to allow the collectors of the output transistors to be connected directly to the heat sink, the output transformer can be made simpler with this design.

The collector-to-collector load which is optimum for the output transistors is very close to 15 ohms. This is equal to the voice coil impedance of the types of speakers likely to be used with the amplifier. It is therefore possible to use a simple centre tapped choked in place of the output transformer and connect the speaker across the choke.

Centre tapped speakers suitable for the job are not available and, even in the future, may not be the best proposition for this type of service.

Use of the choke does not limit the output impedance of the amplifier to one value. A correct match for the transistors can be obtained even with low impedance speakers simply by tapping the output choke and using it as an auto transformer.

The driver stage of the Mullard circuit uses a power transistor of the same type as used in the output stage so that there is an adequate reserve of drive available. It is just possible to drive the output transistors with some of the low power audio transistors but we feel that it is poor design to make an amplifier in which the drive stage overloads almost as soon as the output stage.

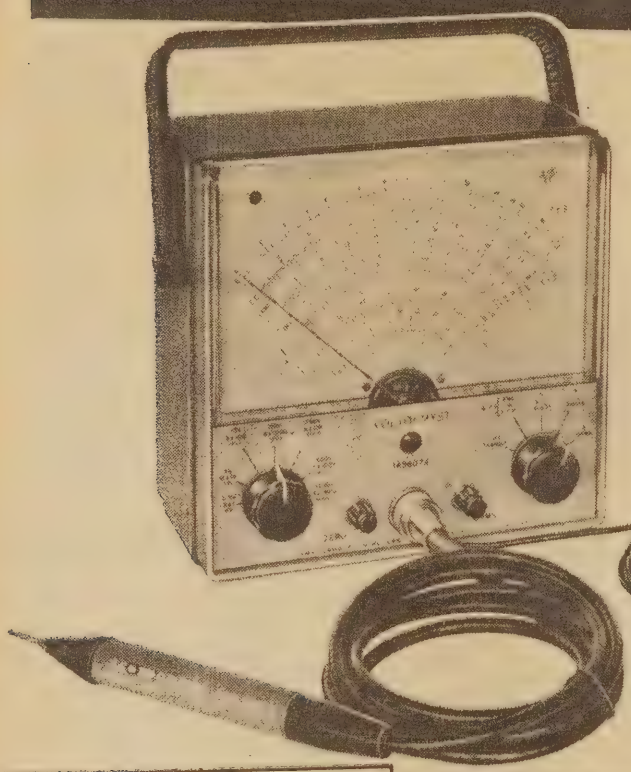
A direct coupled pair precedes the driver transistor in a circuit which saves components, gives a higher degree of temperature stability than the normal resistance capacity combination and at the same time AC and DC feedback.

ADDITIONAL STAGE

For microphone operation yet another stage is required. This can be a small audio transistor, resistance-capacity coupled to the following stage.

Microphones available through ordinary trade channels include crystal,

A.W.A. VOLTOHMYST
TYPE 1A56074



The new A.W.A. Voltohmyst type 1A56074 features a large 7-inch meter extending the full width of the instrument case: thus providing convenient and open easy-to-read scales.

The unit retains the same high quality standards as set by its well-proven predecessor, Model A56010.

Truly a valuable addition to every service shop.

PRICE
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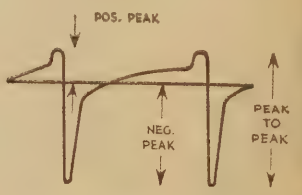

IF YOU HAVE TO MEASURE DC VOLTAGES

- of positive or negative polarity.
- from 0.02 volt to 1500 volts.
- in the presence of rf voltages.
- under conditions of fluctuating line voltage.
- in extremely high-impedance circuits.

You need the
A.W.A. VOLTOHMYST

IF YOU HAVE TO MEASURE AC VOLTAGES

- of complex waves from 0.2 volt to 4200 peak-to-peak volts.
- or sine waves from 0.1 volt to 1500 rms. volts.
- in the presence of DC voltages.
- over a wide frequency range.
- without excessive circuit loading.

You need the
A.W.A. VOLTOHMYST

IF YOU WANT THE ADVANTAGES OF

- 7 peak-to-peak AC voltage ranges.
- 7 rms. AC voltage ranges.
- 7 DC voltage ranges.
- 7 resistance ranges.

ALL in continuous progression WITHOUT any ranges skipped.

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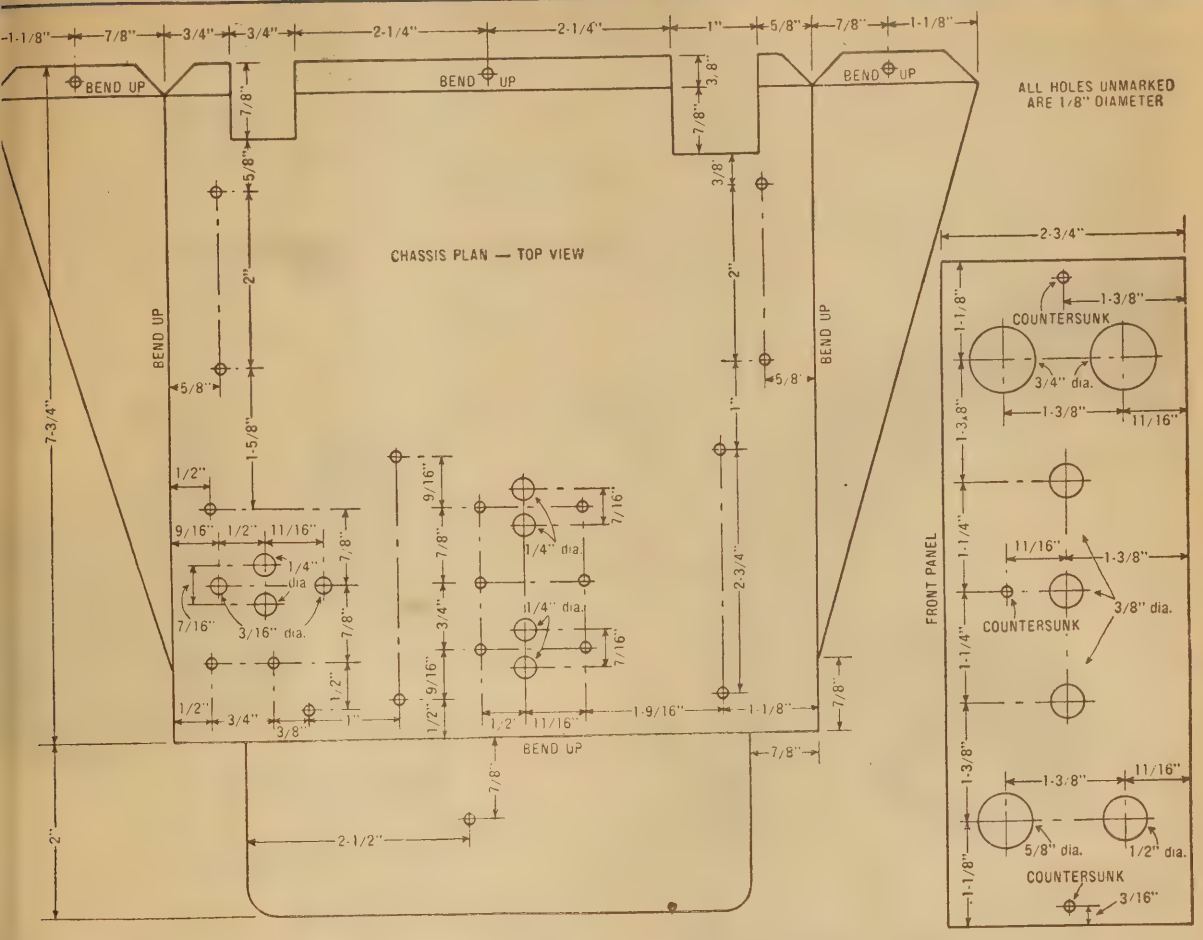

The chassis should preferably be made from 16-gauge aluminium to ensure good transfer of heat from the transistor collectors. It can be made, as shown, from a single piece. The front panel is attached separately.

ynamic and carbon types. In the cheap and medium grades, the crystal usually gives the best quality for a given sum of money. However, it does not stand up well to high temperatures and is therefore not always a good choice for use in hot climates or in the summer sun of ordinary climates.

It is not suitable for use with transistor amplifiers in the ordinary way, because it is basically a high impedance device. Should a series resistor be connected to present the correct load, the effective output voltage is so low as to be comparable with, or even below, the input transistor noise level.

The input impedance of the transistor stage is usually of the order of 1,000 ohms.

DYNAMIC MICS

Dynamic microphones are usually made with a voice coil impedance of 50 ohms and with this value will work well directly into the base circuit of the transistor.

More effective output can be obtained by including a step-up transformer between the voice coil and the amplifier input. Common transformer secondary impedance values are 200 ohms and 500 ohms.

Although it is heavily damped by the input of the transistor, even a transformer designed to feed into the grid of a valve will give good results.

Good quality dynamic microphones are quite expensive but the latest medium quality dynamics can be bought for little more than crystals. They are able to withstand a good deal of mechanical shock without damage and will retain their characteristics at higher temperatures. Their frequency response and output appear to be much better than the dynamics which were available a few years ago.

The new amplifier is suitable for use with any dynamic microphone with an output impedance of 50 ohms or higher.

Magnetic pickups nowadays are usually confined to the expensive and high quality types making it a little out of proportion to buy such a pickup expressly for use with the amplifier. If you already have one you would like to use, it may be connected in a manner similar to the dynamic microphone.

The resulting output will tend to have a rising treble characteristic. This can be partly offset by turning the tone control to treble cut but something more elaborate would be needed for more exact compensation.

Crystal pickups deliver quite a high output voltage and, although they must be fed into a high resistance load in order to give the desired rising bass characteristic, the output available after the necessary voltage division is still above the noise level.

CRYSTAL PICKUP

Cost of a crystal pickup in the medium quality bracket is comparatively low and therefore we recommend such a pickup for the new amplifier.

Mixing of the pickup and microphone outputs is made possible by including separate preamplifiers for each channel. Even with the very simple mixing circuit shown, there is virtually no interaction between the channels.

Feedback from the output terminals

Every time I bought a record, I used to set up the calibrated microphone, connect the oscilloscope, start the music with bated breath, and — consumed with anxiety — I would keep my eyes glued to the screen of the cathode ray tube. If anything on the 'scope pattern looked suspicious (something always did), I would start checking tubes, voltages and crossover frequencies, and examine the record grooves under a microscope.

Then, at the house of a musician friend, I heard a Philips Hi-Fi System. I was suddenly carried away by the sheer joy of listening! What a lovely sound! Clean tight bass; creamy smooth highs; crisply defined middles . . . the strings went la-lah-de-dah; the kettledrums went dum-dedum . . . it was music!

I rushed out of my friend's house to the nearest hi-fi dealer, bought my own Philips Hi-Fi System, took it right home with me . . . and I am a different person today. Man, just listen to that music!

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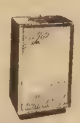
P1728-59

8 Watt High-Fidelity Amplifier EV4430

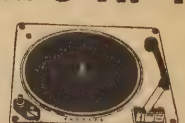


Bass Reflex Enclosure 1053

8" Twin Cone Speaker 9710m

12" Twin Cone Speaker 9762m

Stereo Control Unit EV4407



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he amplifier to the base of the driver sistor minimises most of the distortion helps to improve the frequency re-nse. While not in the ultra high lity class, the amplifier will give a d account of itself if provided with a lity microphone and speaker.

he second feedback loop operates r the two previous stages and has al ly been mentioned.

he remainder of the circuitry includes usual precautions against shift in rating point with temperature and ce-pling to prevent feedback between es. Standing collector current for driver and the two output transistors best adjusted individually when the plifier is complete. In the normal y this will not require readjustment.

INDING RESISTANCE

ncluded in the temperature stabilising work for the output transistors is the stance of the driver transformer sec-lary winding. In fact, with the stand-transformer being made available ough the trade, external resistance has be added in order to make up the uired value.

he total DC resistance of the trans-mer winding plus the external resistor uld be 5 ohms, a value worth remem-ing if you wish to use transformers er than those specially designed for job.

f when you first complete the am-ier, you don't have access to a mul-eter to adjust the three lots of stand-current, it is quite in order to set all ee resistors to their maximum value switch on. Distortion will be higher n normal, but by adopting this pro-ure no damage can be done.

he largest components in the ampli-are the driver transformer and the put choke. Had some special form of struction been employed, it would e been possible to make the amplifer remely small. However, most of the e it is likely to be carried in a car the very small size is not likely to any special advantage.

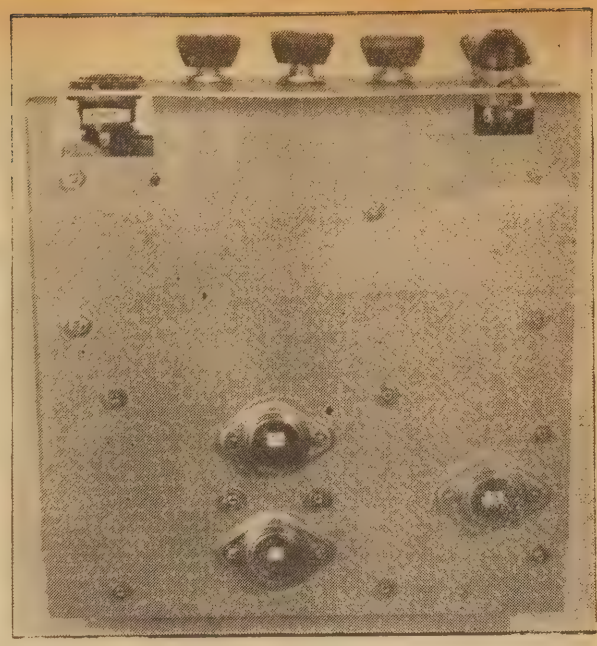
n the other hand, it is an advantage, ticularly to readers with little previous erience if all the components are laid in a manner which makes construc-n easy. While keeping the amplifier sonably compact, we have arranged construction so that practically every nponent is visible.

SSEMBLY BOARD

he two preamplifier stages plus the following stages are laid out on a ce of punched bakelite. It would be elatively simple matter for a manu-turer to design a printed wiring board ed on our original and there is a good nce that such a board will be avail-e in the future.

Transformers, power transistors, large ctrolytic capacitors and associated re-ors are mounted on the metal base-te which also holds the wiring board the high powered stages. Aluminium per or brass all of which are good nductors of heat are to be preferred the baseplate: mild steel is good chanically but its ability to conduct t is not nearly so good as the others.

Mounting of the output transistors is aightforward since the collectors are ectly connected to the plate. Good ntact over the entire flat surface of the nsistor is desirable and care should be en to remove burrs from around the four holes which are necessary for each transistor.



Photograph underneath baseplate shows power transistors. Output transistor collectors are bolted directly to baseplate. Driver transistor is insulated with a mica washer. Surface of chassis under the transistors should not be painted.

The driver transistor must be insulated from the baseplate. Mica washers and fibre washers to insulate the holding bolts are normally supplied with the transistor.

Power dissipated by the driver transistor is less than that dissipated by the output transistors but at the same time it is desirable that good thermal contact between its collector and the baseplate, through the mica washer, be made.

LOW DISSIPATION

Dissipation of the previous transistor is lower again. While a heat sink may not be strictly necessary in order to comply with the manufacturer's recommendations, we would suggest that one of the small clip-plates sold for the purpose be attached to the transistor. The plate can then be mechanically supported on a pillar attached to the wiring board.

So much for a fairly general discussion of the amplifier's circuitry, performance and power supply requirements, with a few specific points thrown in. It now remains to discuss the circuit and construction in more detail.

By the way, while our circuit uses many of the ideas from the Mullard circuit mentioned earlier, it does not follow it in every detail.

Input to the amplifier is accepted by three-pin plugs, one to each of the two identical input channels. Shielded plugs may not be necessary because the circuit operates at quite a low impedance. One pin of each of the plugs is connected to the common positive line and acts as a return for both input circuits and also as a return for the relay coil circuit when the amplifier is operated "press-to-talk."

The fact that one of the leads is common to both the control and microphone circuits does not result in any interference signals being applied to the input of the amplifier because there is no ripple on the supply from dry batteries or an accumulator not under charge. The third pin in each case connects to the base of its respective preamplifier transistor via a 25 uF capacitor.

Dynamic microphones, whether they have a transformer fitted or not would normally be connected direct to the plug. The input impedance of the amplifier is of the order of 1,000 ohms. If the microphone has a 50 ohm voice coil, therefore, the damping will be slight but a reasonably smooth microphone should work well in this way.

If resonances result in peaks in the output, you could connect a 50 or 100 ohm load resistor inside the microphone plug. Should your microphone have a high secondary impedance transformer fitted it will be very heavily damped when connected directly to the base of the transistor.

The several microphones we tried in this way worked perfectly and delivered about the same effective output as when the 50 ohm voice coil was connected directly to the input circuit. However, if this is not your experience, you could connect a resistor, of say 10,000 ohms in series with the lead to the base so that the microphone is presented with a more normal load.

Crystal pickups must be presented with the correct load resistance in order to give full bass response. The correct load will normally be recommended by the manufacturer and will be in the range from 250K to 680K.

LOW FREQUENCIES

Actually, where widest coverage is required with a public address amplifier, there is something to be said for attenuating the lower frequencies slightly in which case a slightly lower load than recommended may be used.

For example, if the manufacturer recommends 470K, you could choose 330K with a slight loss in the lower frequencies but a higher effective average output from the pickup.

Remembering that the divider formed by the series resistor and the input resistance of the amplifier results in only 1/300th to 1/500th of the voltage generated by the cartridge actually being delivered to the transistor base, it is desirable to keep the attenuation as low as possible in order that the signal be high in relation to the transistor noise.

Installation of the series resistor in the connecting plug, rather than in the amplifier itself means that you may use a combination of microphone and pick-

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Manufactured to operate from 12, 24, 32, 50, 110, 240 volts D.C. supplies, and produce an output of 240 volts 50 cycles at wattage up to 150 watts.

SPECIFICATIONS

The Glenradio Inverter, is fitted with a heavy duty vibrator which generates 50 cycles with stability of plus or minus one cycle, thus allowing the use of synchronous motors, such as in radiograms, tape recorders, fans etc. All hash and interference is eliminated to allow perfect reception of radio signals and for use with tape recorders, amplifying systems etc. Special models with different inputs and outputs other than listed, will be manufactured on application.

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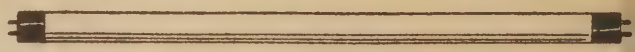
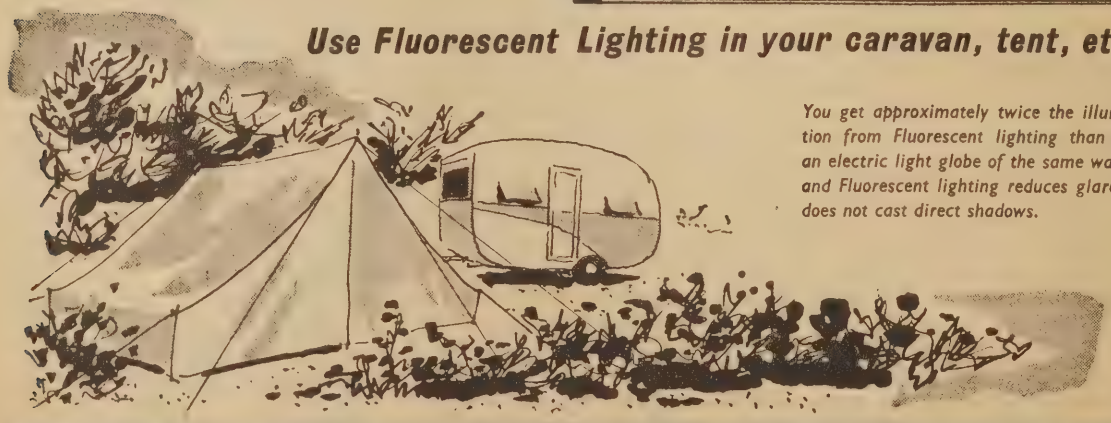


Use Fluorescent Lighting in your caravan, tent, etc.



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654

p or two microphones without alteration of the amplifier circuitry.

Both input transistors operate in a ommon emitter circuit with bias stabisation circuits. Suggestions that the nput transistors should be connected in he common collector circuit for use vith crystal pickups have been made. The input impedance can then be made bout 100K ohms and the series input esistor to present the correct load, that nuch smaller.

However, the disadvantage is that the ommon collector stage does not provide oltage gain. A mathematical analysis roves that the position with regard to oise is about the same, if not even a ittle worse with the common collector han with the common emitter circuit.

TRANSISTOR NOISE

Our laboratory tests have shown that here are quite wide variations in the oise generated by transistors, even those of the same type and manufactured in he same batch. If, therefore, you should e troubled by noise, we suggest that you ry another transistor.

Types recommended are TS2, TS14 and OC71. You could also use the OC70 although the overall gain may then be a little lower than that of the original aboratory model. Types TS3 and TS13 could also be used but the gain may be higher than necessary.

Incidentally, if you wish to economise and require only the one input channel, here is no reason why the second input channel should not be omitted. Simply eave out the second input plug and all the circuitry up to and including the volume control potentiometer.

In wiring the input circuits, you should be particularly careful to avoid any return path common to the input and power supply or output circuits because the impedance of even a couple inches of wire is sufficient to cause instability.

The layout of the schematic circuit diagram gives a good idea of how the wiring should be carried out. If, for example, the positive power lead were transferred from its present position and connected into the amplifier at the positive terminal of the input socket, part of the positive supply rail, would be common to the input and output circuits. Even if the amplifier does not oscillate at low levels, it may break into intermittent oscillation on peaks of signal.

MIXING CIRCUIT

Two potentiometers connected in a simple circuit without the customary series isolating resistors form an effective mixing circuit with negligible interaction between the two controls. The simplification is made possible because the mixer is feeding a low impedance circuit.

Following the mixer is a direct coupled pair which has the advantage over the normal resistance capacity arrangement, not only of saving components, but also of better stability with respect to change in temperature. Supply of the forward bias for the first transistor from the emitter of the second results in negative feedback, both in the DC and the AC sense. The former improves the stability of the operating point and the latter improves the frequency response and reduces the distortion.

By connecting a small capacitor across the bias resistor the response at very high audio frequencies is reduced.

A further attenuation of the higher frequencies, variable to suit the tastes of the operator, is brought about by a potentiometer in the collector circuit. A capacitor is connected between the supply and the moving arm of the potentiometer, maximum treble attenuation taking place when the capacitor is connected across the entire 2,000 ohms.

There are a number of transistors which can be used in the direct coupled pair. Types which come to mind for the first are OC71, TS2, TS3, TS13 and TS14. For the second stage you could use an OC72, 2N185 or 2N291.

Drive for the final class B pair is provided by a power transistor. Types 2N250, 2N301 and OC16 are suitable. The first two have very similar characteristics, but the current gain of the latter is a little lower. Also for the latter, it will be necessary to omit the 1.5K resistor in series with the current setting potentiometer in the base circuit in order to set the collector current to the correct value.

If the output transistors be either 2N301s or 2N250s, the collector current of the driver transistor should be adjusted to 200 mA. For OC16 output transistors we recommend that you set the collector current of the driver transistor at 250 mA.

Power developed at the collector of the driver transistor is passed on to the output transistor base circuits via the special driver transformer mentioned earlier.

Although the secondary windings of the transformer are intimately connected magnetically, they are insulated electrically. You have to make sure that the secondaries are connected in the correct phase and also that the ends of the one winding are connected to the base and collector circuits of the one transistor. If your completed amplifier proves to have very low output and gain, one of the first things to look for is an incorrect connection here.

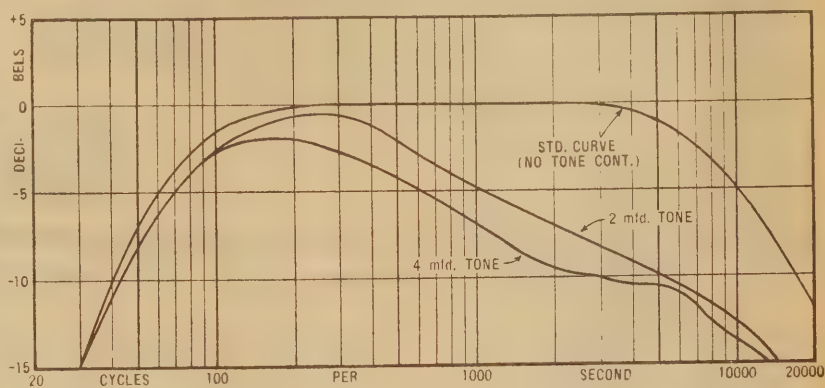
BASE BIAS

The secondary winding of the transformer forms part of a dividing network to supply bias to the base of the output transistor in each case. The total resistance of the winding should be 5 ohms. Transformers being made available for the amplifier appear to have secondary resistances of about 3.5 ohms. Therefore, it is necessary to add an external resistance of 1.5 ohms.

The other part of the divider consists of a 500 ohm potentiometer. This should be adjusted until the standing collector current of the output transistor is 30 mA in each case.

It is desirable that the output transistors be a matched pair. Should they not be matched, the negative feedback circuits will reduce the distortion very considerably, but it will still be higher than with selected output transistors. Manufacturers of transistors realise this point and there should be no difficulty in obtaining suitable pairs.

A choke is used in the output circuit.



The curves above show the response overall of the transistor amplifier and the effect of two values of "tone control" capacitor. The response is adequate for P.A. work.

The push-pull load for the output transistors should be about 15 ohms, and for a normal 15 ohm speaker it is merely necessary to connect the speaker across the choke. There will be no DC component through the speaker voice coil.

For a 3.75 ohm speaker or thereabouts, connection should be made between the centre tap and one end of the choke. There will be a DC component through the speaker voice coil, but it will not be of any significance because the resistance of the speaker voice coil is very much larger than that of the section of the choke winding involved.

2-OHM VOICE COILS

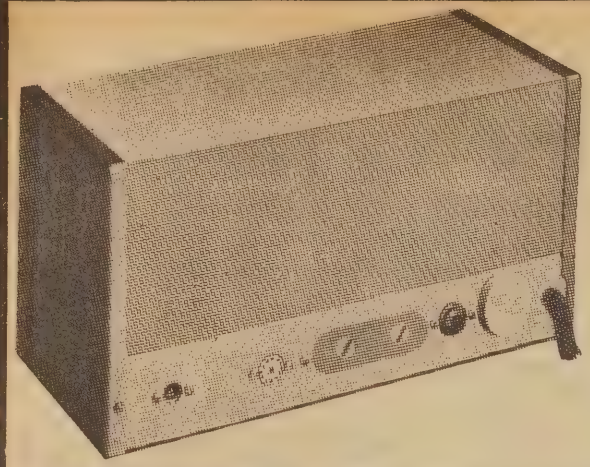
Speakers with 2 ohm voice coils will be connected between the centre tap and the 2 ohm tap on the choke. The consideration with regard to the DC component is the same as for the 3.75 ohm speaker.

Two 15 ohm speakers in parallel will be closely matched if they are connected between the "2 ohm" tap and the opposite end of the output choke, while two 2 ohm speakers would best be connected in series and between the end of the choke and the centre tap. If you have speakers of other impedance you will find that there are many possible combinations which will deliver a desirable ration of power to each speaker and at the same time correctly load the amplifier.

Feedback from the output choke to the base of the power driver transistor helps to smooth the frequency response and keep the distortion down to a low level. Since the feedback is always taken from the same point, there is no need to change the value of the feedback resistor with the various speaker connections mentioned above.

The relay in the supply line can be bypassed by a switch when the press-to-talk feature is not required.

Reversal of battery polarity will damage the transistors, and, since the amplifier is likely to be connected to all types of batteries by people with varying



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SUPPRESSING METER ZERO WITH ZENER DIODES

This article describes a simple method for expanding the range of any D.C. microammeter or low-range milliammeter with a diode.

By M. L. SNEDEKER

THE occasion frequently arises for the accurate reading of voltages over a limited range.

Zero-suppressed instruments are used for this purpose; all voltages below a certain value applied to the meter cause no movement of the pointer, and the scale is calibrated so that the lowest voltage value takes the place of the conventional zero.

Such meters usually employ specially shaped pole pieces and are relatively expensive. By using a silicon-junction diode of the zener type, a conventional meter can be used to provide zero suppression over a wide range of voltages.

The uni-directional characteristics of germanium and silicon diodes are well-known. The ratio of back resistance to forward resistance is quite high, varying with the type of diode and the operating voltage.

If a potential of "opposing" polarity and sufficient magnitude is applied to a conventional germanium diode, a very small reverse current will flow. Reference to the characteristic charts will show it to be limited to an extremely small value. If this value is exceeded, the diode will be destroyed.

ERRATIC REVERSE CURRENT

The reverse current so caused tends to be erratic, varying greatly from diode to diode. Note also, in Fig. 1, that the reverse current increases gradually as the reverse voltage is increased. In contrast, the silicon-junction diode provides a repeatable, stable, reverse-current characteristic with a definite conducting voltage.

As used in voltage-regulator applications, a zener diode is normally connected as shown in Fig. 2. This is the familiar voltage-regulator circuit used with conventional VR tubes and functions in much the same manner; the voltage across the diode remains almost constant over wide variations in the unregulated supply voltage.

Zener diodes with a breakdown voltage held within 5 per cent of rating are available; power handling capabilities range from 250 milliwatts up to 10 watts.

This type of diode has an extremely high back resistance and, of additional importance, is its property of conducting "all at once"; a relatively sharp breakdown voltage value exists below which very little current flows.

This sharply defined breakdown-voltage characteristic can be utilised by connecting the diode in a straight series arrangement as shown in Fig. 3.

In the conducting condition, the resistance of the zener diode is relatively low. However, at voltages below breakdown, its resistance is very high and little current flows through it.

Consequently, no indication will appear on the meter and, by using a diode having the proper breakdown voltage, we can cause the meter to begin to read at almost any desired value.

We thus have available the entire scale for reading of voltages over the range in which we are interested. Two or more diodes can be placed in series to produce the desired breakdown voltage. This suppressed-zero feature can be obtained with any D.C. microammeter or low-range milliammeter.

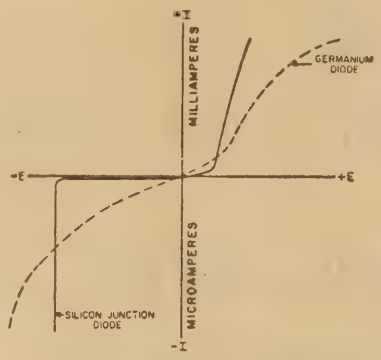


Fig. 1. Reverse-current characteristics.

Fig. 2. Zener diode employed as regulator.

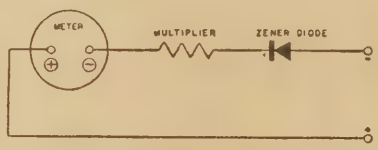
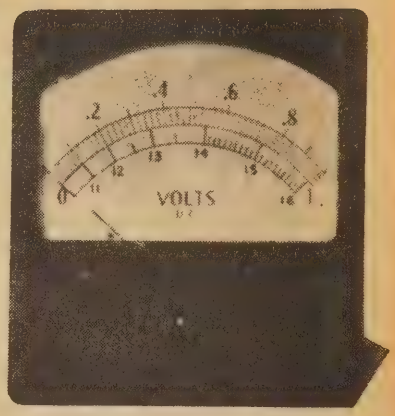


Fig. 3. Diode used to suppress meter zero.

Table 1. Typical voltage ranges obtained.

ZENER DIODE	VOLTAGE RANGE 0-100 μa. METER	VOLTAGE RANGE 0-1.5 ma. METER
International 1N470	3.5-10	6-15
Transitron SV 818	17.5-32	20-32
Hoffman 1N1789	24-65	46-100

Note: All diodes rated 750 milliwatts.



This meter was modified to produce a wide scale between 14 and 16 volts for the adjustment of automotive voltage regulators. The meter starts to read at about 10 v.

The scale must be calibrated for the range desired, using a known accurate standard. The series multiplier will have to be determined by experiment.

Some typical voltage ranges, the regulator diodes, and DC meters used are shown in Table 1. It will be noticed that the "threshold" voltage is higher when the less sensitive meter is used; the very small current flowing just below the zener breakdown is not perceptible on this meter scale.

In the meter illustrated, an open scale was desired in the 14-16 volt range for the testing and adjustment of automotive voltage regulators. Two 1N470 diodes were connected in series. The full-scale sensitivity of this meter is 100 microamperes; its internal resistance is 540 ohms.

This simple method of obtaining the suppressed-zero feature makes possible the construction of a most useful instrument with a minimum of expense.

(From "Electronics World.")

10-WATT TRANSISTOR AMPLIFIER

(Continued from Page 73)

knowledge of electrical things during its lifetime, some protective device is desirable. Our suggestion is that you connect a germanium power diode in series with the supply as shown in the circuit diagram. If the amplifier is connected in the wrong polarity it will then simply not work and no damage will be done. There is a small voltage drop across the diode and if your installation is such that there is no possibility of the battery being connected the wrong way around, by all means, leave the diode out when the maximum power output will be slightly higher.

Current 12-volt vehicles have the negative side of the battery earthed in some cases and the positive side in others. Contact between the chassis of the amplifier and the metalwork of the car or truck could cause a short circuit when the positive side of the battery is grounded and it is therefore necessary to insulate the chassis effectively. This will be done by a wooden case, which we propose to describe next month.

To conclude, a few precautions on wiring transistor circuits may be worth while. Do not cut the leads to the transistors off short. Leave at least an inch long and use a pair of long-nosed pliers as a thermal shunt between the solder joint and the transistor. Do not work on the circuit with the power switched on. Current transients can damage the transistors.

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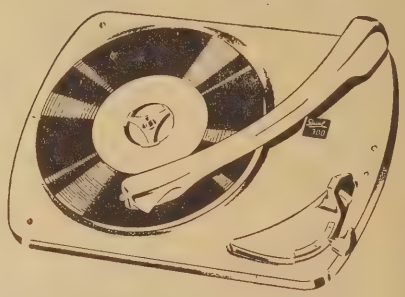

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Here's your answer, Tom!

Tom's queries this month are many and varied. Perhaps Tom is training to compere a quiz show, or maybe it is just plain curiosity. Whatever the reasons are behind these queries, the ones we have selected should prove of interest to most readers, who probably have similar problems of their own.

What is a Hartley circuit?

A Hartley oscillator circuit is one containing a parallel tuned circuit connected between the anode and grid of a valve, a tapping point on the inductor being connected to the cathode or the HT supply. A typical circuit is reproduced herewith.

Whether the tapping point is connected to the HT or the cathode it is at zero signal potential and the positive feedback path between the anode and grid circuits is provided by the mutual inductance between the two parts of the inductor.

The circuit shown is the shunt-fed type. It is distinguished by the fact that the anode current passes through an RF choke, while the inductor is coupled to the anode circuit through a capacitor. This constitutes a barrier to DC. but has a low reactance at the signal frequency. With this circuit the tapping point may be earthed.

The alternative scheme is to apply B-plus to the plate via the CT and the coil. This obviates the need for an RF choke, but does put HT on the coil and capacitor, which is a disadvantage in some cases.

Either way, the basic operation of the circuit is unchanged.

★ ★ ★

What is a Klystron?

The klystron is a valve which finds application in the generation and amplification of centimetric waves.

Its action is such that the electron stream is made to form into bunches by the use of a cavity resonator. The valve comprises an oscillator whose feedback arrangement is formed by interconnecting two cavities through a tube. The cavities are known as the buncher and the catcher. The catcher is also the anode and is earthed.

The cathode is biased negatively with respect to the anode and electrons are accelerated towards the buncher opening, which acts as a grid in controlling the electron stream. The action of the buncher is to accelerate and repel, in turn, the electrons arriving from the cathode so that bursts of electron flow arrive at the mouth of the catcher.

The bunched electron beam passing the mouth of the catcher excites the cavity resonator into oscillation and, because of the interconnection between the two cavities, there is constant feedback of energy, and hence regeneration like that of any oscillator.

Since the velocity of the electrons must be changed to cause bunching, the valve is often called a velocity modulation valve.

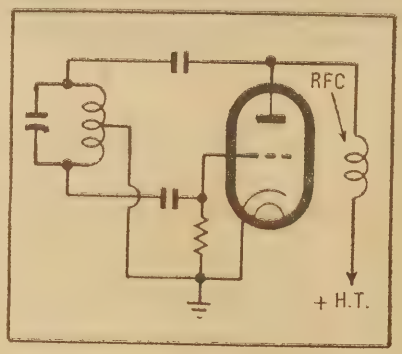
★ ★ ★

What are Kirchhoff's Laws?

Kirchhoff's Laws facilitate the calculation of the currents in a complicated arrangement of resistances. There are two of these.

Kirchhoff's first law states that at any junction of resistances the sum of the currents towards the junction is equal to the sum of the currents flowing away from it. This law merely expresses the fact that electricity cannot accumulate at any point of a circuit.

The second law is a generalisation of



Circuit of a typical Hartley oscillator.

Ohm's Law and states that, in any closed circuit the sum of the EMFs, assumed positive in the direction of the current and negative in the opposite direction, is equal to the sum of the products of current and resistance in every part of the circuit; in other words, it is equal to the sum of the voltage drops.

★ ★ ★

What is Eureka wire?

Eureka wire, Tom, is a type of wire made from a nickel and copper alloy. It can withstand high temperatures without deterioration and is used for winding resistance coils and heater elements.

★ ★ ★

What is an equipotential cathode?

The term "equipotential cathode" describes a characteristic of an indirectly heated cathode. This is a characteristic which a filament does not possess.

In a directly heated valve the filament, heated by current from a battery, has a higher positive voltage at one end than at the other. The anode to cathode volts therefore differ according to which point of the filament is taken as a reference.

The same is true of a simple strand filament operated from an A.C. source.

When the cathode is indirectly heated the cathode obviously has the same potential along all parts of it and is called an equipotential cathode.

The same applies to any cathode which has the same potential at all parts of it, such as the cold cathode of a glow tube.

★ ★ ★

What is a gold-leaf electroscope and what is it used for?

The gold-leaf electroscope, Tom, is a device for indicating the presence of an electrostatic charge. The essential part of the device is a pair of small slips of gold leaf suspended from the end of a metal rod so that they hang side by side. The rod is fitted through the insulating cap of a glass jar and the electrostatic charges are applied to the end of the rod.

When a charge is applied to the rod it spreads over each leaf and, because like charges repel, the leaves will move apart.

★ ★ ★

What is the velocity of electrons within a valve?

The velocity attained by an electron travelling in a vacuum or rarefied gas and accelerated by electric and magnetic fields or a combination of both is in the order of tens of millions of miles per hour.

The values of velocity expressed in miles, feet or centimetres per second are so cumbersome (and rather pointless) that it is usual to express velocities in terms of a potential difference.

Because an electron, urged by an electric field, is accelerated just as a body falling from a height is accelerated by gravity it may be said that electrons or ions "fall down" a potential gradient.

Thus it is common to speak of an electron velocity of, say, 10, 100 or 10,000 volts rather than in terms of speed and distance.

★ ★ ★

What is the electron lens?

The electron lens, Tom, is a name given to the arrangement for focusing the electron stream in a cathode-ray tube. The method of focusing may be either electrostatic or electromagnetic. It may be affected by the electrostatic field created either between the first and second and second and third accelerators or by the magnetic field from a focusing coil placed around the neck of the tube.

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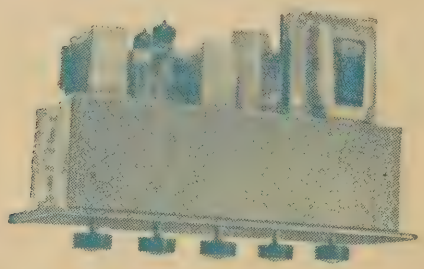

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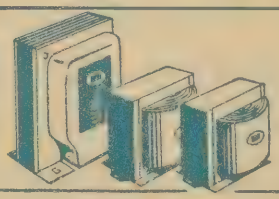

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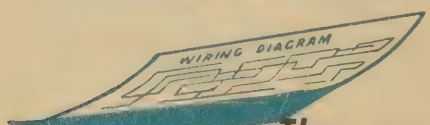

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In the electrostatically focused tube the focusing field is formed by the electrostatic strain created between adjacent accelerators, the control of focus being provided by varying the voltage between the accelerator electrodes. The effect on the electron stream is to make the electrons bunch toward the centre of the field and so form a narrow beam.

With electromagnetic focusing, the field is so arranged as to be parallel with the path of the electrons. Electrons moving parallel with the field are not deflected, but those that diverge from the path are deflected by the field and will take up a spiral path on their way to the screen. By correct adjustment of the field strength electrons can be brought to a focus on the screen.

The field strength may be varied by changing the current through an electromagnet. Alternatively, permanent ring magnets may be used, their fields being made to affect the electrons passing through the centre by moving the magnets closer together or further apart.

★ ★ ★

What is a passive element in an aerial?

A passive element in an aerial, Tom, is an element which is not directly connected to the receiver or transmitter, but is excited by induction. A passive element may be either a reflector or a director, according to its dimensions and whether it is placed behind or in front of the active element.

As a practical example, the active aerial may be a half-wave dipole. A reflector would be placed about a quarter of a wavelength behind and should be slightly longer than the active element. A director, on the other hand would be placed in front of the active element, roughly at the same distance and should be slightly shorter.

The spacings and dimensions are largely a matter of obtaining the correct phase relationships to produce reinforcement of the radiation in a particular direction and for a particular frequency.

★ ★ ★

What is pulse-code modulation?

Pulse-code modulation, Tom, is a method of transmitting intelligence in which the message is conveyed from the sender to the receiver by interrupting the carrier to produce regularly occurring groups of pulses.

According to a prearranged code, the pulses in a group give information at any instant about the amplitude of the modulating wave at that instant.

The message thus, instead of being transmitted by varying some property of the carrier wave in accordance with the modulating wave as in amplitude and frequency modulation, takes the form of a series of "instructions" which are reconstructed by the receiving apparatus.

The equipment used for this system is quite complex and has the disadvantage of requiring a wide band width and, if used for a radio link, it is confined to the metric or centimetric wave-lengths.

On the other hand, it has two distinct advantages. One advantage of pulse-code modulation over other methods is that it enables a very good signal-to-noise ratio to be obtained.

This is because modulation is effected by a series of pulses and their amplitude and waveform do not greatly matter. At the receiver these pulses, in fact, are only required to trigger a relay, and this triggering occurs with certainty, provided the pulses are appreciably greater than the noise at the receiver input.

It is thus possible to obtain perfectly shaped pulses from distorted ones and noise can be reduced greatly.

Because the system works satisfactorily in spite of a poor signal-to-noise ratio at the receiver input, it permits low sending power and consequent economy in running costs.

A second advantage of this system is that the transmitted messages can only be interpreted if the pulse code is known, thus permitting transmission in comparative secrecy.

★ ★ ★

What is pulse measurement of the ionosphere?

Pulse measurement of the ionosphere is a method for determining the heights above the earth of the various ionospheric layers.

As this method measures the height of maximum electron density, it gives the central height of the layer only.

You are most likely aware of the fact, Tom, that radiations reach a receiver by means of two paths, that travelling along the ground and that reflected by the ionosphere. Because of the greater distance it has to cover, the ionospherically reflected wave arrives later than the ground wave.

Since the velocity of radio waves is 186,000 miles per second, the time lag between the ground and ionospheric rays is very short, being of the order of one thousandth of a second, but increasing as the distance from the sender increases.

The measurement is made by sending a very short pulse of radio energy upwards into the ionosphere, its reflection being received by a station a couple of miles away. The ground ray is also received.

The output of the receiver is fed to the deflecting plates of an oscilloscope, and, provided the speed of the time base is suitably adjusted, the screen of the oscilloscope shows a succession of large pulses due to the ground ray, each of them followed by a second pulse corresponding to the reflected signal.

Since the speed of the time base and the velocity of the wave are both known, it is a simple matter to calculate the time taken by the impulse to reach the ionosphere, be reflected, and reach the earth again. From this information the height at which reflection occurs is calculated.

For measurement of the higher layers care is taken to select the frequency which is high enough to pass through the lower layers without reflection. If the frequency selected approaches the critical frequency of the lower layer, two reflected pulses may be observed on the screen of the oscilloscope, one from each of the layers.

★ ★ ★

Does the thickness of an aerial make any difference to its performance and is there any advantage in using stranded wire?

Assuming that you are talking about an ordinary aerial for an ordinary broadcast or short-wave receiver, Tom, you are not likely to notice the difference between an aerial made from ¼-inch rod or an aerial of the same length made from 40-gauge wire. The main difference would be physical and not electrical.

Aerial wire is usually stranded but, that is only because it is more durable. So, Tom, you may go ahead and erect an aerial using whatever wire you may have on hand, keeping in mind the more obvious points regarding strength and durability.

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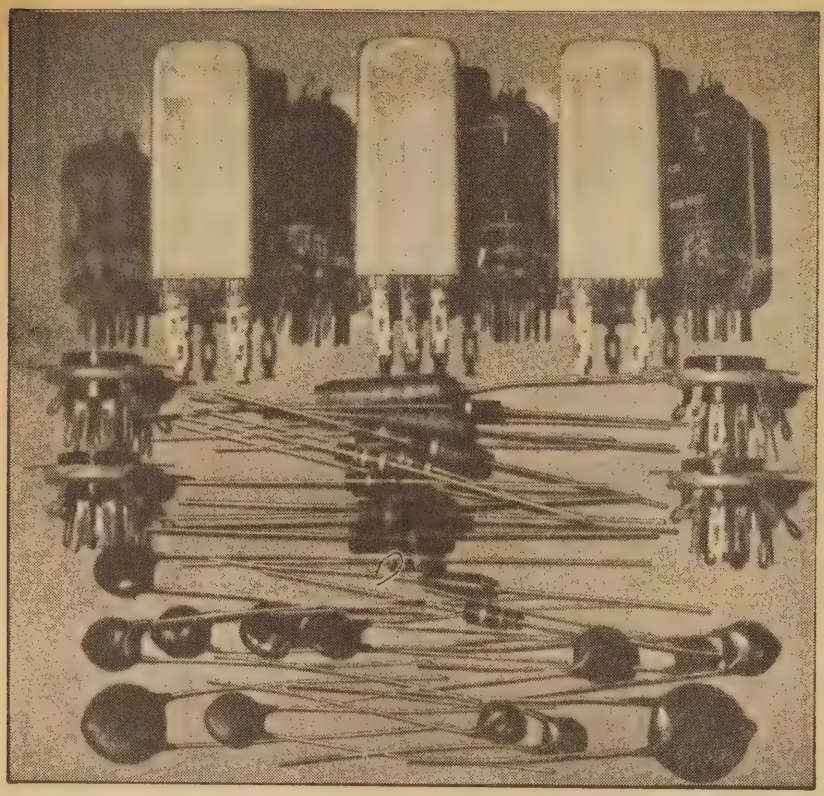


This group of components is currently necessary in an FM receiver for amplification, oscillation, conversion, limiting, detection and A.F.C. All these components could be displaced, with some present loss of efficiency, by a single tunnel diode. This statement comes from General Electric scientists.

Radio's Newest Baby - The Tunnel Diode

Unless your knowledge of semi-conductor theory is a good deal better than average, you will not understand everything in this article. But read it just the same. It will give you some background in this completely new and revolutionary device.

The tunnel diode is a revolutionary new semiconductor device. Although it can perform many of the functions of conventional devices, its principles of operation are entirely different from the operating principles of other semiconductor devices and vacuum tubes.

Such conventional amplifying devices as transistors and vacuum tubes depend on emitting a charge carrier into a region where its motion can be influenced by a signal electrode, and on subsequently collecting the charge carrier on an output electrode.

The speed of this conventional amplification process is limited by the time it takes a charge carrier, having left the emitter, to traverse the control region, and appear on the collector.

This time is generally quite long compared, for example, to the time it takes for a signal to travel an equivalent length along a copper wire. The reason is that, in the wire, the signal is carried by the electric field of all of the electrons in the wire, rather than by the motion of a particular group of electrons.

Each electron in the wire moves only a microscopic distance, and those coming out the other end are not the same ones that went in as signal.

The signal in a tunnel diode moves with the same rapidity as does a signal travelling along a copper wire. It is for this reason that the diode has such a short response time.

The difference between the tunnel diode and the copper wire, of course, is that the copper wire cannot amplify. The wire has a positive resistance: that is, an increase in the voltage results in an increase in the current.

In the tunnel diode, an increase in the voltage can result in a DECREASE in the current. That is, it has a NEGATIVE resistance. It is for this reason that the tunnel diode can act as an amplifier and perform its many other functions.

Instead of absorbing the signal as a resistor does, it increases it.

To understand the tunnel diode involves a knowledge of the nature and behaviour of semi-conductors.

A semiconductor has a forbidden region where there are no states available for its electrons. This region is called the band gap. The states below this gap (which comprise the valence band) are almost all filled. The states above it (the conduction band) are almost all empty.

ADDING IMPURITIES

The number of empty states in the valence band, or electrons in the conduction band, can be controlled by adding either acceptor impurities or donor impurities to the semiconductor crystal. Each acceptor impurity takes one electron out of the valence band, and each donor gives one electron to the conduction band.

In this way p-type (empty states in valence band) and n-type (electrons in conduction band) regions can be built into a crystal.

The surface where two of these regions touch each other is called a p-n junction.

Figures 1 and 2 represent the conduction and valence bands in the vicinity of a junction at different values of applied bias. One can see that as the bias is increased the bands which overlap each other at zero bias become uncrossed. Since tunneling is represented by a horizontal transition on this picture, the current decreases as the bands become uncrossed.

The tunnel diode takes its name from the tunnel effect—a process wherein a particle (obeying the laws of the quantum theory) can disappear from one side of a potential barrier and appear instantaneously on the other side, even though it does not have enough energy to surmount the barrier. It is as though the particle can "tunnel" underneath the barrier.

In the case of the tunnel diode, the barrier is the space charge depletion region of a p-n junction. This is the same barrier which prevents the current from flowing in the reverse direction in the case of the ordinary rectifier diode.

In the tunnel diode, this barrier is made extremely thin (less than a millionth of an inch)—so thin, in fact, that penetration by means of the tunnel effect becomes possible. This gives rise to an additional current in the diode at very small forward bias which disappears when the bias is increased.

It is this additional current, called the

saki current in honor of the scientist ho first observed it, that produces the egative resistance in a tunnel diode.

The origin of the Esaki current can e qualitatively understood by consider- g the changes in the characteristics of conventional p-n junction diode as one oes to higher and higher concentrations free carriers in the semi-conductor ystal.

As one increases the density of the arge carriers, the reverse breakdown oltage decreases. One might think that here would be a limiting case when the everse break-down voltage was reduced zero.

OLUBILITY

This is not correct, however; the limit determined by the solubility of the npurities which determine the carrier oncentrations. Experiments have shown at one can dope many semiconductor aterials more heavily than is needed reduce the breakdown voltage to zero.

If one does dope more heavily, the iode can still be in reverse break- own condition at a slight forward ias. When a larger forward volt- ge is applied, the diode goes out of he reverse breakdown condition, and he current falls to a small level.

The reverse breakdown current that ows with a forward applied bias is the saki current.

Through studies of tunnel diodes made om many different materials in many fferent ways, General Electric scientists ined new knowledge of the operation the device. This additional insight led the solution of most of the problems sociated with the tunnel diode.

As a result, it was possible to develop improved tunnel diode which, because its vastly superior electrical character- tics, is a versatile and useful new mponent.

The availability of these improved ex- rimental tunnel diodes, in turn, made rther research possible, and it was the search on these improved diodes that d to a major scientific discovery, which s explained the most puzzling aspect the tunnelling process.

PECIAL PROBLEM

One of the unanswered questions re- rding the operation of the tunnel di- e was that the tunneling process seem- to occur equally well in materials th indirect band gaps and in materials th direct band gaps.

An indirect band gap is one where the inimum energy state in the conduction nd occurs at a different value of mo- entum from that of the maximum en- gy state in the valence band. In other ords, an electron would have differ- t momentum after tunneling than it d before tunneling.

This would seem to violate the classic- laws of the conservation of moment- n. It would appear, therefore, that the nneling process was in some way more mplicated than the simple concept merly held.

Additional evidence that the tunneling ocess was more complicated was un- vered by General Electric scientists. is evidence involved the appearance some mysterious "wiggles" in the rrent-voltage characteristics which were easured on tunnel diodes made from con cooled to very low temperatures

MANY USES FOR TUNNEL DIODE

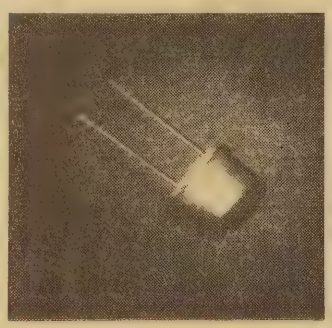
The newest "baby" in the fast-growing family of electronic devices—the "tunnel diode"—is coming of age. The new device, little over a year old, is better understood and closer to commercial application as a result of an intensive research program, according to Dr. Guy Suits, General Electric vice president and director of research.

The tunnel diode, first reported in 1958 by Japanese scientist Leo Esaki, is first cousin to a transistor, but operates on a different principle and offers advantages that the transistor does not. Before long it should find its way into high-speed computers, television sets, communication equipment, nuclear controls, satellites and space vehicles, Suits predicted. He said:

"Further advances in the design and application of tunnel diodes can be expected, and it is probable that transistors and other solid-state devices will also benefit from the new knowledge."

The improved tunnel diodes are still in the experimental stage, and are not yet commercially available. However, to spur progress in circuit design General Electric's Semi-conductor Products Department has plans to offer limited quantities of experimental samples for such use within the next few months.

The tunnel diode takes its name from the physical phenomenon that makes it possible: "quantum-mechanical tunnelling". The term is used to describe the manner in which the electrical charges move through the device. Such motion takes place



A developmental tunnel diode, much larger than production types will need to be.

with the speed of light, in contrast to the relatively slow motion of electrical charge carriers in transistors.

The high speeds at which electrical charges travel in the tunnel diode make it possible for the device to operate at extremely high frequencies. Oscillation frequencies higher than 2000 megacycles have already been obtained, matching advanced transistor performance, and frequencies of more than 10,000 megacycles are expected in the near future.

The device's high speed response also suggests applications in computers. When used as switches, tunnel diodes have functioned in a fraction of a milli-microsecond — from 10 to 100 times as fast as the fastest transistor.

The device also resists the damaging effects of nuclear radiation. Because it is less dependent on the structural perfection of its crystal than is the transistor, it is much less affected by the damage that radiation can do to such crystal structures. In this respect it outranks transistors by more than 1000 to 1.

VARIOUS METALS

Semiconductors that have thus far been used by scientists for making tunnel diodes include silicon, germanium, gallium arsenide, gallium antimonide and indium antimonide.

The tunnel diode is smaller than a transistor and, because of a simpler structure, ultimately will be a small fraction of its present size. It also is little affected by environmental conditions. Silicon tunnel diodes made by General Electric work at temperatures as high as 650 deg. F; conventional silicon diodes will not operate above 400 deg. F.

As an electrical circuit element, the tunnel diode exhibits a unique combination of electrical properties including what is called a "negative resistance" over part of its operating voltage range. These characteristics allow it to be used in a wide variety of applications, such as an amplifier, a generator of radio-frequency power, and a switching device.

The simplicity of this device makes possible the development of "integrated circuits", in which entire circuits for some applications may be formed on a single semiconductor structure.

It is superior to vacuum tubes and transistors for applications in low-noise amplifiers and mixers for high frequencies. Many parametric amplifier jobs, for example, could be performed more easily by tunnel diodes.

Acting on the hunch that these "wiggles" were related in some way to the conservation of momentum problem, further experiments were performed, and the hunch was proven correct.

The "wiggles" correspond to tunneling processes which are assisted by an ultrasonic vibration of the crystal. These vibrations of the crystal, called phonons, turned out to have exactly the right frequency for momentum conservation.

The identification of this process has enabled the scientists, in turn, to analyse the performance of the tunnel diode devices in greater detail, and to increase further their usefulness as electrical circuit components.

From the point of view of basic science

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is work is also extremely important. he ultrasonic vibrations are about 100 mes higher in frequency than any co erent vibrations produced heretofore. his is, therefore, an important new tool r investigating the vibrational proper- es of solids.

Measuring the size of the "wiggles" elds information concerning the engths of the electron-phonon inter- tions of the crystal. The spacing of the viggles" yields information regarding e frequencies of the phonons, and the eadth of the "wiggles" discloses some the effects of impurities on the spec- um of the phonons.

One can expect that improvements in nventional semi-conductor devices, as ell as in tunnel diodes, will result from ese discoveries and from the new re- arch that they will make possible.

OMMUNICATION FIELD

In the field of communication, tunnel odes compete with transistors, parame- c amplifiers, vacuum triodes, magne- ns, klystrons, travelling wave tubes, d masers. The pertinent characteris- s for comparison in this field are max- um oscillation frequency, minimum wer requirements, and low noise am- fication.

For computer applications, the tunnel de competes with transistors. The ide is at least 100 times faster than lay's transistors, and can be made to only about 1/100th as much power. reover, the tunnel diode is insensitive temperature changes, in contrast to transistor.

The improved stability of the tunnel de may make it possible to take short s in circuitry without sacrificing relia- ty.

The following summary should be of erest.

MAXIMUM OSCILLATION FREQUENCY

(In Kilomegacycles)

unnel Diode—2 Kmc (10+ Kmc in w years; 100+ Kmc is conceivable).
ransistor—2 Kmc.
arametric Amplifier—6 Kmc.
acuum Triode—10 Kmc.
aser—10 Kmc.
lose Space Triode—10 Kmc.
ravelling Wave Tube—60 Kmc.
lystron—75 Kmc.
agnetron—100 Kmc.

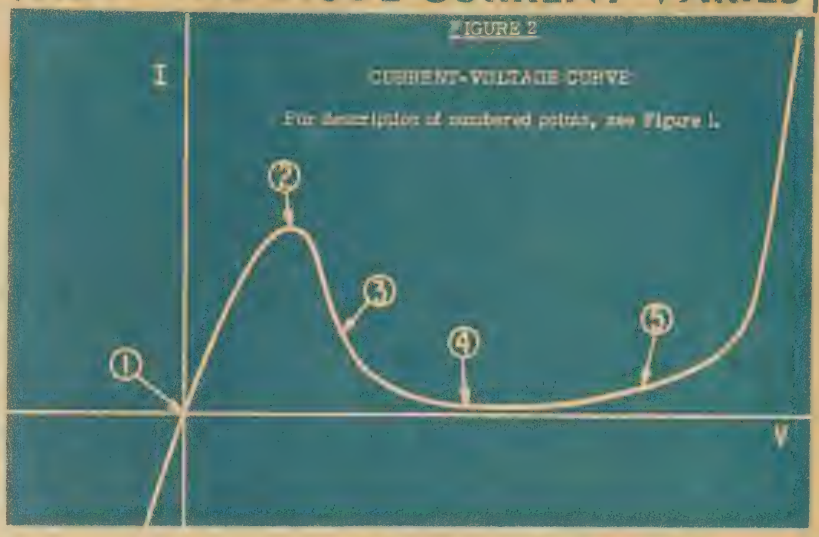
NIMUM POWER REQUIREMENTS

unnel Diode—one-millionth of a watt
ransistor—one-thousandth of a watt.
acuum Triode—one-tenth of a watt.
lystron—10 watts.
ravelling Wave Tube—10 watts.
arametric Amplifier—10 watts.
agnetron—20 watts.
aser—400 watts.

OW NOISE AMPLIFICATION

oise Temperatures (at a frequency of 0 megacycles). Noise Temperature portional to noise level).
aser*—20 deg. K.
rametric Amplifiers*—35 deg. K at n temperature: 20 deg. K when cool- With liquid nitrogen.
nnel Diode*—100 deg K to 300 K
avelling Wave Tube—300 deg. K.
ystron—300 deg. K.
cuum Triode—90 deg. K.
ansistor—3,000 deg. K.
Note: In the area of low noise am- ation, only parametric amplifiers and masers compete closely with tunnel diodes. The tunnel diode is the only one of these three devices capable of operating directly from a battery The parametric amplifier and the maser require an additional source of radio frequency power, and the maser requires an additional cryostat for cooling, and a magnet for bias.

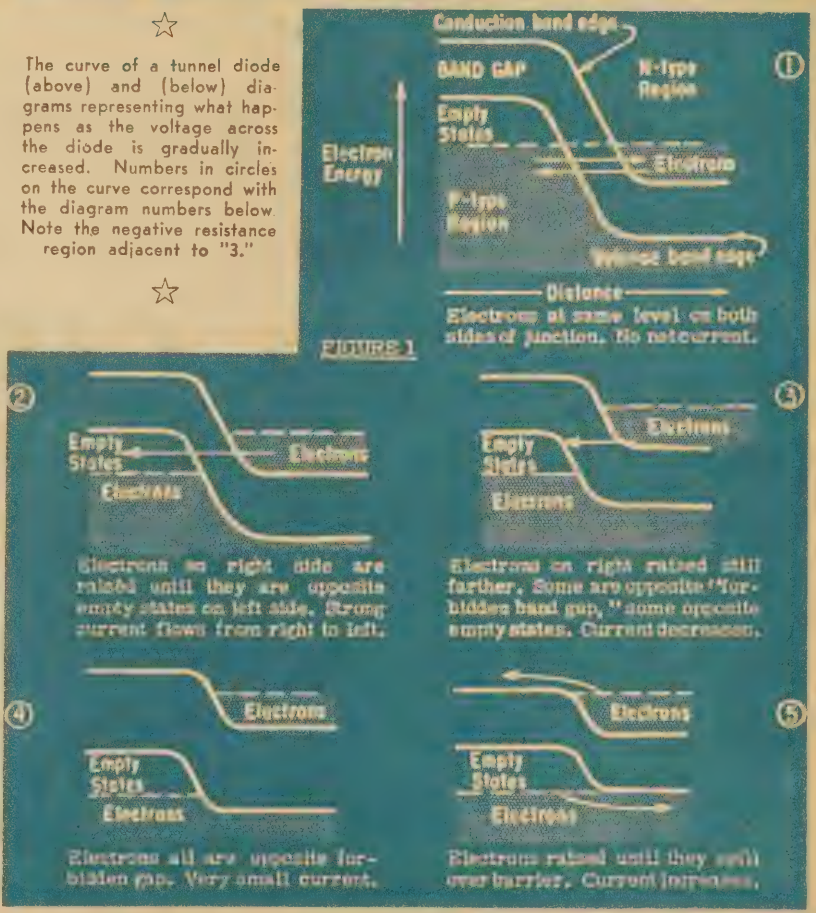
HOW THE DIODE CURRENT VARIES



☆

The curve of a tunnel diode (above) and (below) diagrams representing what happens as the voltage across the diode is gradually increased. Numbers in circles on the curve correspond with the diagram numbers below. Note the negative resistance region adjacent to "3."

☆


Conduction band edge
BAND GAP
N-type Region
Empty States
Electrons
Electron Energy
P-type Region
Valence band edge
Distance
Electrons at same level on both sides of junction. No net current.
FIGURE 1
Empty States
Electrons
Electrons on right side are raised until they are opposite empty states on left side. Strong current flows from right to left.
Electrons on right raised still farther. Some are opposite "forbidden band gap," some opposite empty states. Current decreases.
Electrons all are opposite forbidden gap. Very small current.
Electrons raised until they spill over barrier. Current increases.

APPLICATIONS

RADIO TRANSMISSION

The tunnel diode will have important applications whenever small size, light weight, low battery drain or extreme stability and ruggedness are needed Some examples are:

1. Personal communications transmitters.
2. Vernote telemetry where power requirements are stringent, such as in weather balloons.
3. Satellite communications.

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11	Aerial Filter Kit	93/4
20	¾ amp Line Filter	31/4
26	¾ amp Line Filter with condensers	60/-
22	5 amp Line Filter with condensers	60/-
24	2 amp Line Filter	37/4
27	2 amp Line Filter with condensers	43/4

Above prices are trade plus 25% Sales Tax

PRINTED CIRCUITS

558	Amplifier Audio Transporta 6 and 7	20/-
559	RF Section Transporta 6	20/-
562	RF Section Transporta 7	20/-

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DIALS AND KNOBS

453	Dial and Knob 300pf Gang	10/-
455	Dial and Knob 415pf Gang	10/-

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TRANSISTOR COILS & IF's

Part No.		
248	Osc. Coil	7/4
249C	Aer. Coil and Ferrite Rod	14/-
174	Single Tuned IF 455kc	11/4
175	Single Tuned IF 455kc	11/4
176	Dble. Tuned IF 455kc Med Gain	11/4
177	Dble. Tuned IF 455kc High Gain	11/4
178	Dble. Tuned IF 455kc low Gain	11/4

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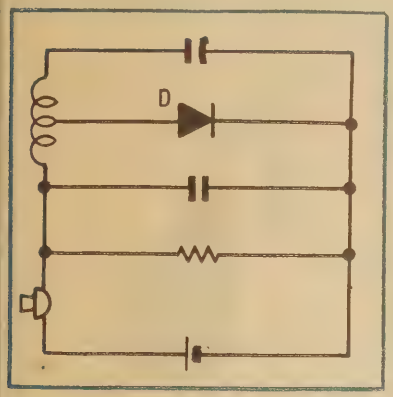
4. Medical research and diagnosis. A small pill-sized transmitter can relay information about its surroundings within a living organism to the outside world without the encumbrance of wires.

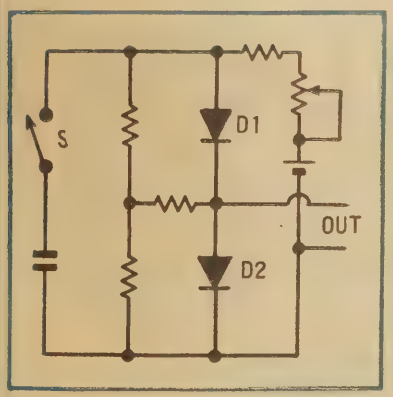
RADIO RECEPTION

The tunnel diode will have application whenever simplicity, low noise, low power requirements or high frequencies are important, namely:

1. Personal communication.
2. Television receivers (especially if UHF is included).
3. FM receivers.
4. Detectors for broadcast and short-wave receivers.
5. Special low noise receivers for high frequency. (Example: radar



A miniature elementary FM transmitter using a tunnel diode and demonstrated recently in the U.S.



A flip-flop counter circuit using two tunnel diodes.

for commercial airlines and military).

AMPLIFIERS

The tunnel diode will have application whenever environment makes conventional devices inefficient or inoperative.

1. Atomic power. The tunnel diode provides a radiation resistant amplifier for relaying measurements inside atomic reactors. This may eventually make reactors that are better controlled and safe to operate.
2. Low noise pre-amplifier for high frequency radio purposes.
3. Control devices for rockets and nose cones where high temperature operation is needed

COMPUTERS

The tunnel diode will find its way into the computer field first because of its high speed. Other considerations are the high and low temperature operation. Radiation tolerance, the low cost per unit, stability and rugged reliability. Low power.

GENERAL PURPOSE CONTROL

The tunnel diode can act as a current switch. It can be used both as a warning device that switches a control current when a particular thermal or electrical situation is encountered, or it can be used as a control device that switches the current being delivered to some other unit.

1. Thermostats.
2. Protective devices for motors or other equipment.
3. Current flow indicators.

D.C. TO A.C. CONVERSION

The tunnel diode is important as a D.C. to A.C. converter, because its operation voltage is so low. For this reason it matches the output of thermo-couples, thermionic converters and solar cells.

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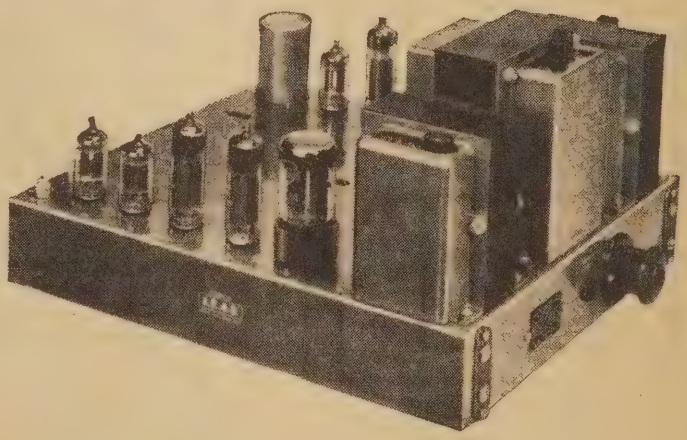

WHARFEDALE

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A HIGH-GRADE HOME-BUILT MOVING COIL GRAMO PICKUP

In this rather unusual contribution, a reader describes how he built his own moving coil gramo pick-up. Those who like to tackle projects in miniature may be interested in building one for themselves. In the following article our contributor, Mr E. N. Andersen, tells his own story.

HAVING a liking for microgroove records and the very best in pickups but an inelastic pocket, it was obvious that if I bought a high-grade pickup I would be unable to purchase an occasional record to feed it with. So I decided to roll my own, and with gratifying results.

A moving coil design seemed possible and to have a reasonable chance of satisfying the requirements of high quality, home building and no cost—or almost.

TOO DIFFICULT

As the D'Arsonval type of construction appeared to be too difficult for the kitchen table, it was decided to retain the rubber-mounted trunnion bearings of yesteryear, but to use a light, non magnetic assembly incorporating a coil moving in a magnetic field and driven by a sapphire stylus.

The magnetic field could be supplied by the magnet of the small plug-in Garrard 78 r.p.m. pickup head which was chosen for re-vamping. The original case of brown bakelite is quite attractive and serves admirably to house the new assembly.

The tube for the trunnions, the stylus mount and the members holding the moving coil were all made from .004 shim brass which had been tinned on each side as lightly as possible with solder.

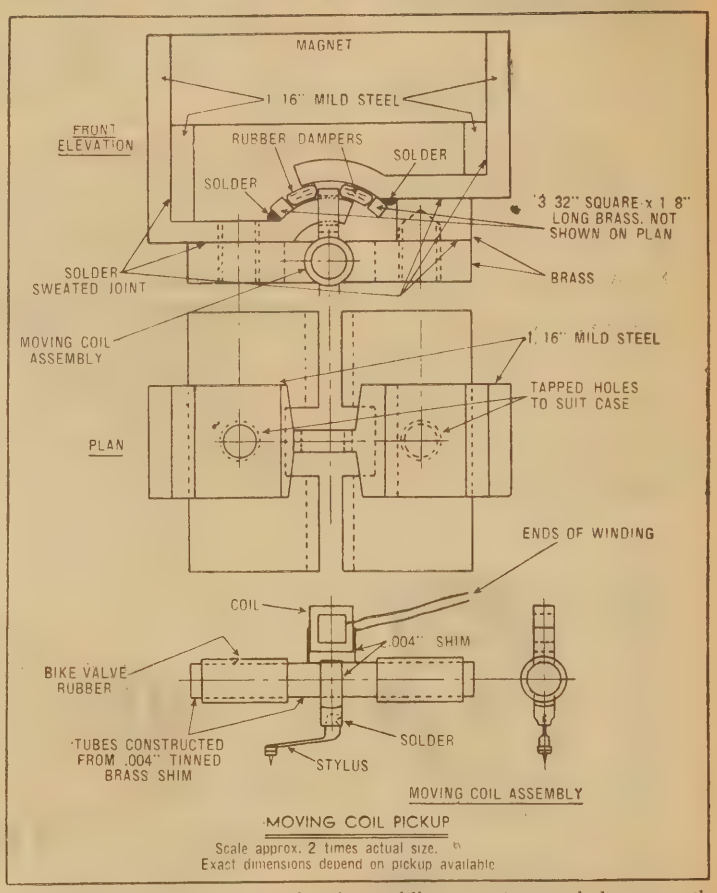
Some of the shim was rolled around the shank of a 3/32in drill, with as little lap as possible, and sweated to form the trunnion tube. Not sweated to the drill, of course. The stylus support was made on a 1/16in drill by the same process.

The moving part of the pickup, less the coil, can now be assembled. Holding two 1/16in strips shim brass so that they form a cross, sweat them where they intersect, and then sweat them to the tube so that the one on top is at right angles to the tube. The lower one is sweated to the tube for slightly less than 1/16in each side of the transverse one, so that subsequently its end may be bent up to hold the coil.

The ends of the transverse strip are wrapped around the tube until they can hold the 1/16in stylus tube at the opposite side of the coil supports, and the whole thing is then sweated together.

Excess solder must be avoided at all times, as lightness is essential and is not achieved by filling shim brass tubes with solder.

The coil is self-supporting and was wound with the finest available wire (45-gauge in my case) on a slightly tapered square former, with 5/64in sides, filed up from perspex and polished with very fine emery paper—"wet or dry" paper in the finest grade is just right—and finished with metal polish.



MOVING COIL PICKUP

Scale approx. 2 times actual size.
Exact dimensions depend on pickup available

Cheeks for the former are made from scraps of perspex with square holes filed in them to fit the former. They are then cemented to the former parallel to one another and 1/16in apart.

Cement them to the former with a very little chloroform, on the outsides only. This will leave a recess in which the wire can be wound to form a coil with an internal square 5/64in a side and 1/16in long.

Before the coil is wound the former should be well polished with floor wax to prevent the araldite from adhering to it.

The wire is wound in as evenly as possible—a magnifying glass is a great help—and each layer is coated thoroughly with araldite cement. Do not wait for the araldite to set on each layer, as the idea is to produce a coil thoroughly bonded into a block of resin.

Wind as many turns as possible while checking that the finished coil will have clearance in the magnetic gap designed for it (see sketch). The winding must begin and finish at the smaller end of the taper and both ends of the wire must come out near each other.

LEAVE TO SET

When all the wire is on, any surplus araldite is wiped off and the coil left to set completely.

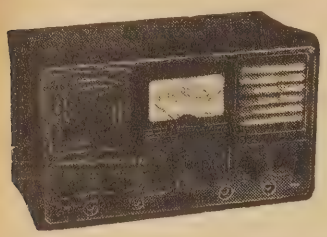
When completely set the cheeks are filed away as much as possible and if the chloroform was not applied too lavishly the central portion of perspex can be driven through the coil and no difficulty should be experienced in releasing the coil from the cheeks.

The wire and araldite should form a solid block.

The pole pieces and the magnet sup-

TRADE IN YOUR OLD INSTRUMENT

Test instruments have advanced greatly in recent years, so why not trade in your old instrument on a new, more comprehensive model? You will receive a good price for your old instrument (regardless of manufacture), which will pay much towards the cost of your new instrument.



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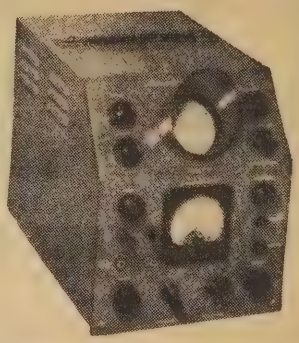

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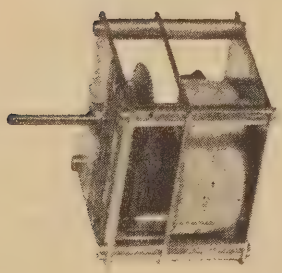
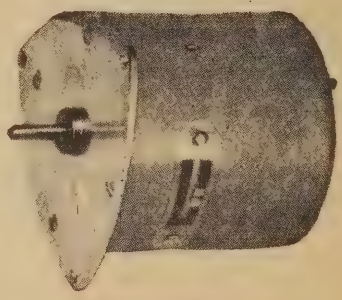


TYPE **BK**
APPROX. 2¼" H. x 1⅞" W. x 1¾"



TYPE **BE**
APPROX. 2-3/16" DIA. x 2"

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rts are made from 1/16in mild steel
eet. The base for the whole assembly
made from a strip of 3/16in brass
out ¼in wide which is filed down to
ickness and width after a 1/8in hole
s been drilled through it from one
16in face to the other.

When it has been filed down to some-
ing under 1/8in thick it will, of course,
come two pieces—think of the saving
hacksaw blades! The two pieces are
ished off as per sketch.

It is wise at this stage to drill and tap
e holes which will be used to hold the
ole assembly on to the base of the
kup case. The case can then hold
e brasses while the pole pieces are
ally shaped and curved.

The pole piece with the smaller radius
ust fit inside the coil and the other
e vertically above it, with the coil free
move in the gap between the two.

When satisfied with this portion of the
sembly, remove it from the case and
eat the pole pieces to their brass sec-
ns (see sketch).

OUNTING COIL

The coil can now be mounted. The
nnions are inserted into short pieces
cycle valve tubing, the coil is fitted
to its pole piece, and strips of thin
luloid are slipped in between the coil
d its pole piece.

The leads from the coil must face the
r of the pickup and can be soldered
the original terminals.

When satisfied that clearance exists,
coil can be cemented with araldite
its supports, after they have been
mmed as per sketch. When the cement
dry the celluloid strips are removed.

Damping blocks cut from the softest
ailable rubber are fitted (see sketch)
d a cantilever type sapphire stylus is
ed after the assembly is again mount-
in its case.

The least amount of solder should be
d to hold the stylus into its tube,
ich is squeezed to hold the end of
stylus, but not too tightly. Remem-
r that the stylus will have to be un-
eated sometime for replacement, and
the tube has not been squeezed too
erely this is a matter of moments
ly.

The stylus point should be perpendicu-
to the record face, and this should
held in mind while the stylus is be-
fitted.

OUNTING ON ARM

The head is now finished and can be
unted in a suitable arm, counter-
ighted to give a pressure on the stylus
int of five or six grams. As it is a
v-impedance pickup a transformer
ist be used. At present I am using
ex-disposals mic. transformer which
reasonable, though one designed for
job is projected.

The performance is excellent. Of
rse, the usual bass boost for mag-
ic pickups must be used as well as
npensation for the recording charac-
istic. Cymbals and triangles sound
ural, and the bass will shake the floor
you want it so.

A stylus for a Philips AG3010 was
d and has given excellent service, last-
much longer in this pickup than they
in the crystal cartridge and so far
re has been no sign of record wear.
om E. N. Andersen, 128 Mitre Street,
hurst, N.S.W.)

NOTE RE PORTABLE, SEPT. ISSUE

The following letter has been received from a reader who contributed to these columns in September last:—

Dear Sir,

Because of correspondence I have received concerning the pocket radio published in the September issue of your magazine, in the "Reader Built It" section, I am sending you further details, and would you please put these in the next available issue to save future correspondence.

1. *The aerial coil is wound on a 2in x 3/8in diam. piece of "Ferroxcube" rod, which is part of the normal 8in x 3/8in.*
2. *The earth symbol signifies a common point—the set does not need a physical earth.*
3. *The .47 optional regeneration control may have to be increased in value—I used a 4M. miniature thumbscrew pot. with switch.*
4. *I used a hearing aid earpiece and mercury batteries and was able to fit the set in a case approx. 2¼in x 1½in x 1in.*
5. *When laying out the circuit on an insulating board chassis, keep the batteries as far from the coil as possible (else Q of coil reduced greatly).*
6. *The capacitor going to the base of the OC44 is a 0.1 mfd not a 1.0 mfd.*
7. *Both the 0.1 mfd capacitors can be replaced by 0.01 mfd, with little effect to performance if the size is important.*

Yours faithfully,
D. L. Haskard.

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Phones BA48

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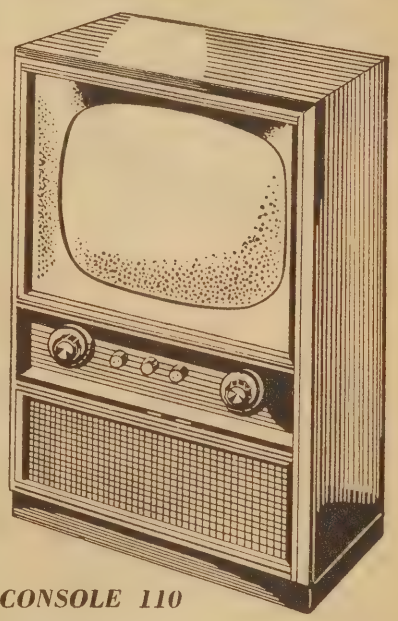

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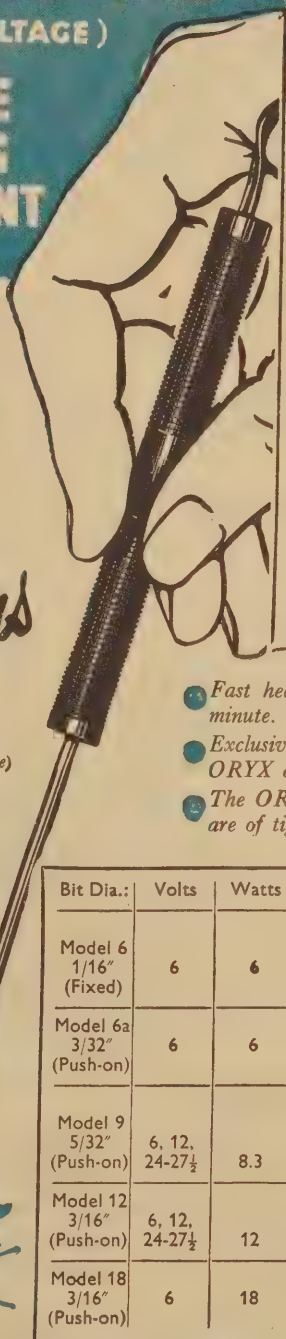

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There is a danger of damage when soldering to transistor leads, due to A.C. leakage currents. The use of a low-voltage transformer supply, with earthed secondary is therefore recommended. Take care also that too much heat is not applied to flying leads. The ORYX iron, and a heat-sink such as heavy pliers gripping the lead between the contact point and the transistor, will ensure protection.

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Model 9 5/32″ (Push-on)	6, 12, 24-27½	8.3	0.25 oz.	6″	Hearing Aids, Radio and TV Sub-assemblies, Coils, Electronic Instruments, Model Construction. Electro-Medical, etc.
Model 12 3/16″ (Push-on)	6, 12, 24-27½	12	0.5 oz.	6.25″	Radio, Television, and Telecommunications assemblies.
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MSP3.58

TRADE REVIEWS AND RELEASES

A.W.V. TRANSISTORS MORE READILY AVAILABLE

The Amalgamated Wireless Valve Company advises that they now have adequate supplies of transistors and semi-conductor type rectifiers.

PICTURED below are the 1N1763 and 1N1764 diffused junction silicon rectifiers, the same type as used in our recent 110-degree television receiver. The rectifiers are rated to operate normally in ambient temperature condi-

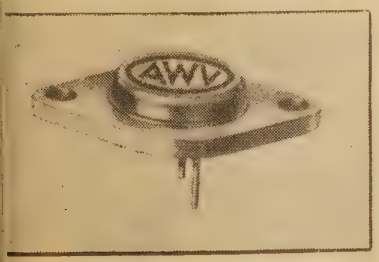
ons up to 100 degrees C. and they are ermetieally sealed to obviate deteriora-on due to external conditions.

The 1N1763 has a peak inverse volt-ge rating of 400, allowing an RMS ıpply voltage of up to 140, with a ıaximum forward current of 500mA.

Equivalent ratings for the 1N1764 are 00 volts peak, 175 volts RMS input ıd 500mA DC output.

In the field of power transistors, the N301 and the 2N301A are preferred 'pes. They are intended for use in car ıdios, in class-B amplifier stages and ther such applications. In class B, two f these transistors will deliver an out-ıt of 12 watts with a power gain of)db. The large-signal DC current trans-r ratio is 70 and is approximately near to 3 amps.

The transistors are hermetically seal-l and the collector is electrically and

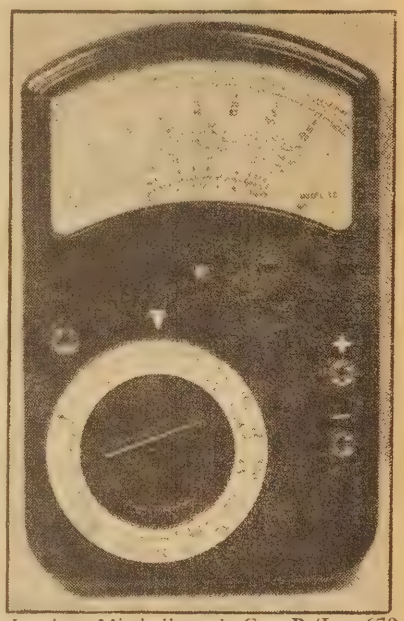


ermally coupled to the mounting inge, to ensure the best possible trans-r of heat to the chassis of the heat nk. Collector dissipation is 11 watts a mounting flange temperature of 80 grees C.

Further details of these and other ansistors are available on application to e Amalgamated Wireless Valve Co. y. Ltd., 47 York Street, Sydney.

MINIATURE METER IS ACCURATE

Clever design by the makers of the Hansen "SC" multimeter has resulted in a complete switch-range multimeter with overall dimensions only 5½in x 3½in x 1in.



THE Model "SC," photographed, sells at £7/2/6, plus tax. There is also a Model HB with a plug and socket system, rather than a switch, which sells at £6/6/6 plus 12½ per cent sales tax.

General quality of both instruments is excellent. A beautifully made 140 uA meter is the basis of the "SC" design which has a sensitivity of 6,000 ohms per volt on the DC ranges and 2,700 OPV on the four AC voltages ranges.

High stability resistors are used as multipliers and shunts while batteries, ohms zero pot., AC coupling capacitor are all included within the dimensions given. A full range of spares, including the meter, is available locally.

DC voltage ranges are: 6, 30, 120, 300 and 600. DC current: 300 uA, 12mA and 300mA. There are three ohms ranges, one with external power plus scales for inductance, capacity and decibels.

Supplies are available from parts distributors. The Australian agents are Jacoby, Mitchell and Co. P./L., 679 Kent Street, Sydney.

ROLA CO. MAKE RECORDING TAPE

In keeping with their expansion into the tape recording field, the Rola Company has announced the release of their own Australian-made recording tape, as pictured below.

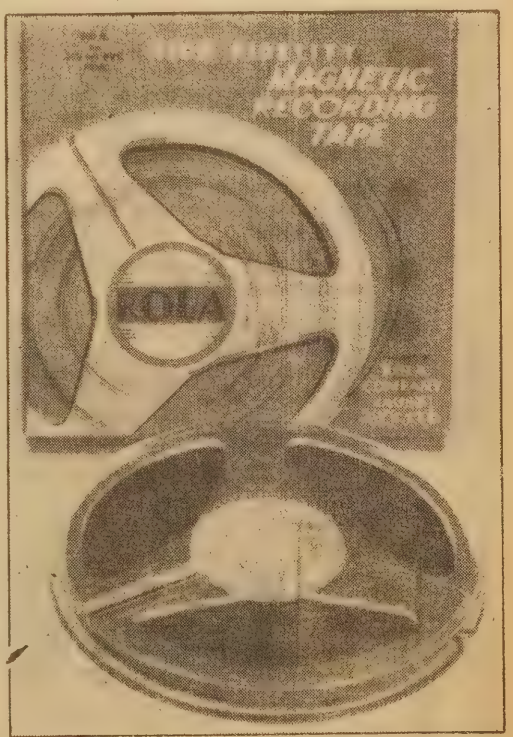
"ROLATAPE" comes in two grades. The first is 1.5 mil. PVC base, general-purpose tape, meeting the requirements of most professional, educational or home recordists.

The second is a premium quality 1-mil. tape using a strong polyester base, which provides about 50 per cent longer playing time on reels of a given size.

Rolatape is spooled and sold on both five and seven-inch reels. These carry 600 and 1,200 feet respectively of the PVC based tape, or 900 and 1,800 feet respectively of the polyester base.

Though exhaustive tests would be necessary to establish the ultimate quality and durability of a tape, the sample submitted for inspection appeared to be mechanically excellent, well spooled and well packaged.

The manufacturers claim a frequency response of better than 15Kc at 7½ips, background noise more than 65db below recording level, modulation noise 50db below or greater, distortion less than 2 per cent and level variation less than 1db along any spool or 2db between spools.



T-E-R-R-I-F-I-C !

NEVER BEFORE SUCH HIGH-PRICE FEATURES AT SUCH LOW, LOW COST

TWO NEW PHILIPS TAPE RECORDERS!

fully equipped for sound-mixing, monitoring and superb high fidelity

Put these two new tape recorders through their paces and you'll recognise their performance as outstanding — their price outstanding value! With either single or three-speed models you can record speech or music with crystal-clear, high-fidelity brilliance. You can make your own sound tracks for home movies; you can monitor during recording. You can tape a recording up to six hours long and, at any stage, you only need to press a button to play back, pause, part-wind backwards or forwards.

- A new Philips recording playback head reduces the width of recording slit to .0002 of an inch, a fraction of the width of a human hair, bringing true high fidelity to all recording and reproduction even at the speed of 3¾ inches per second.
- Separate volume controls for mixing input from mike and player or radio with professional quality.
- "Piano Key" pushbutton operation wholly automatic and trouble-free.
- Friction Brakes • Safety lock prevents accidental erasure.
- Big 7" reels—long playing • Facilities for dictation, conference recording, public address • Many other features.

AT YOUR PHILIPS RETAILER

ER 1500 A

Three Speed "Professional Fidelity" Model **149 gns.**

EL 3515 A

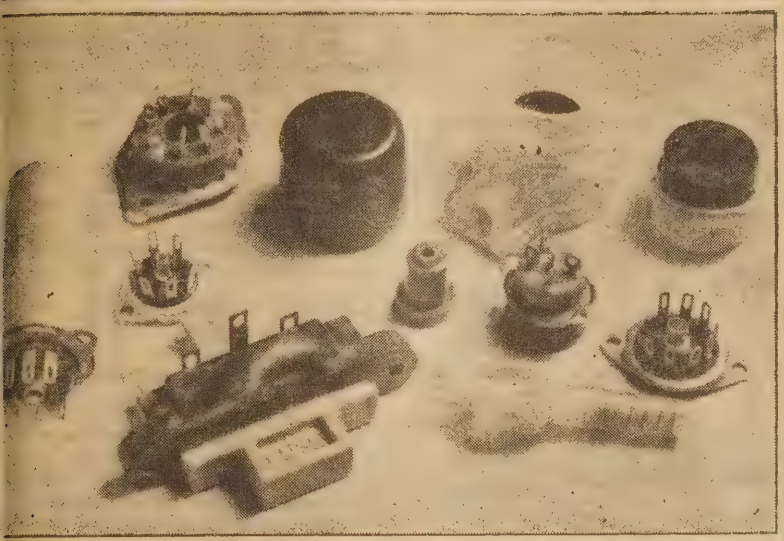
Single Speed 3¾" per second "High fidelity" Model **99 gns.**

PHILIPS

Be sure it's a

PHILIPS

VARIETY OF COMPONENTS FROM M.S.P.



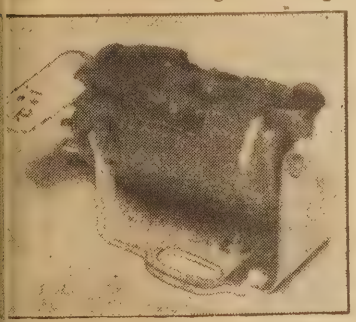
ustrated above are some of the excellent small components currently available rough trade houses from Manufacturers Special Products, a division of A.W.A. ie sockets are manufactured by McMurdo Aust. Pty. Ltd., for whom M.S.P. are Australian agents. The line and chassis fuse holders are made by A.W.A.

HIGH OUTPUT ACOS CARTRIDGES

n addition to their standard Acos turnover stereo cartridge, Amplion A'sia) Pty. Ltd. are now offering two more types each with progressively greater signal output.

IE cartridges are using the same basic construction, but modified to in different orders of output. or high-quality amplifiers, where is not a problem, the original 3-1 cartridge would normally be erred.

owever, simplified amplifier systems not have as much gain as might



lesired and, for these, the GP73-3 idge is offered. It is available with sapphire styli or with a sapphire 78 and diamond for LP, the prices respectively £5/15/ and /18/6.

st before we went to press, advance oles of yet another cartridge arrived, output higher again than that from GP73-3. Quoted as type GP73-5, it aid to be capable of operating tly into the grids of high-slope outvalves.

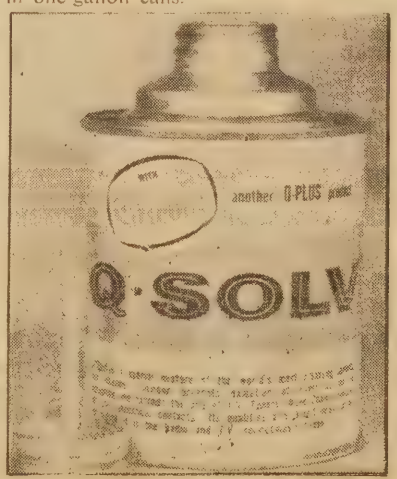
is should make it possible to de- an extremely simple stereo amplifi with, nevertheless, quite high peak ut.

TO CLEAN SWITCHES

AIMED at alleviating the problem of dirty contacts on TV tuners and wave-change switches, Messrs R. W. Steane have recently released "Q-Solv." —a cleaning and degreasing solution.

For workshop use, it is sold in the 10oz can, as illustrated, with sealing cap and nozzle. In this form, the liquid can readily be directed on to individual switch contacts, etc. The price is 7/8 plus 12½ per cent tax.

For industrial use, Q-Solv. is available in one-gallon cans.



For the finest results in sound

PHILIPS

Magnetic Tape

Expert audiophiles specify Philips tape because of its superior recording characteristics and "Full Dynamic" range. Greater sensitivity captures high notes with perfect fidelity, while noise level stays low. Philips Magnetic tape is highly resistant to snapping and tearing; built-in lubrication prevents recording head wear; moistureproof and unaffected by tropical conditions, Philips Magnetic Tapes do not wrinkle or stretch. They are produced to international standards and suitable for all tape recorders.

TYPE NUMBER	REEL SIZE	FOOTAGE
RE 957	7" (long play)	1,700 ft.
EL 3915/5	5" (long play)	850 ft.
EL 3908/50	4" (long play)	400 ft.
EL 3953/60	3" (long play)	200 ft.

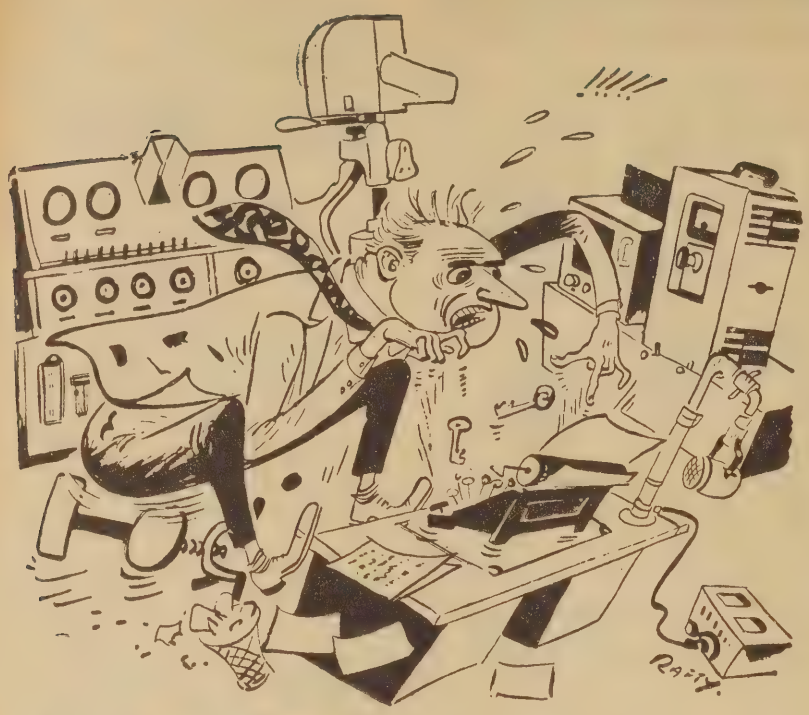
Empty reels available in all sizes

For special applications. ER1600 Super-Synchro-cine Tape (special magnetic tape for synchronous home movies and slides) contains 720 feet of long play tape on 5" reel, with mirror and instructions.

Be sure it's a

PHILIPS

P1727-59



Let's Buy An Argument

They're at it again—those hardy souls who persist in objecting to resistors marked 22K, 47K and so on. Completely ignoring the fact that there may be some very good reason for such figures, they jump to conclusions ranging all the way from technical snobbery to a desire on our part to be just plain difficult.

by Neville Williams

TYPICAL of the letters I refer to is one from R.S. in Tooraweenah. He writes as follows:

Dear Sirs,

Can you tell me why you chaps always quote on your circuits your capacitance in, say, .0047, .047, .47 etc., and your resistance values as 47K, 27K and so on?

What's wrong with .005, .05, .5 etc., and with 50K, 30K and so on?

Is it this critical or do you happen to know that all the resistors and capacitors I have are in 5s and 00s and you just want to be contrary?

Yours faithfully, R.S.

One can't answer every such letter at length but sooner or later the conviction grows that we should clarify the position for the latest batch of "conscientious objectors." Such an occasion has arrived.

The last time we dealt with this question was in July, 1956. On that occasion we went into a long rigmarole, which was supposed to be funny ending up with a statement of the essential facts.

Right now, with half the technical staff off sick, I don't feel very funny, so let's get straight down to facts.

NOT FOR ACCURACY

First and foremost, the currently used system of rating resistors is not primarily a matter of accuracy, as our correspondent appears to imagine. The fact that we specify a figure of 47K for a resistor does not mean, automatically, that it needs to be more accurate than it might have been, had we specified 50K.

The so-called "preferred system" aims rather at rationalising values to meet more adequately, the needs of circu designers and to minimise quite poi less and often misleading duplication stocks.

Because it is based on mathematical derived figures, the values do seem od at first glance. But they are a gre deal more logical than the tradition "round figures," in which we used deal.

In point of fact, these tradition values, based on "round figures," gre up in a completely haphazard way. the article referred to earlier, we e plained it as follows, being nothing l than a simple statement of fact:

ONE MEG. RESISTORS

When a customer wanted a fa amount of resistance, manufacture picked on a nice round number and su plied him with one-megs. This w much too much for another custom so they made him some half-megs.

For those who wanted still small values, they cut the figure by half aga and came up with quarter-megs.

This system of determining standa values had a lot to commend it, becau they were all so easy to say over t phone.

But it seemed silly to make half th again, because it looked such an o figure. So they settled for 0.1 me pronounced "point-one-meg."

But then a very difficult man want twice as many ohms as 0.1 meg a there was nothing for it but to ma him some 0.2 megs. After all, it w still a nice round figure!

Nor was that the end. Custome wanted smaller and smaller values, they made 75,000 ohms, 50,000 ohm 40,000 ohms, 35,000 ohms, 25,000 ohm 20,000 ohms, and so on, right down short-circuits!

Meanwhile, the carpenters were bus building bins to hold all these n resistors and the signwriters wou follow them along, painting on t figures and adding 1 p.c. 2 p.c., 5 p. 10 p.c. and 20 p.c. to each separate bi

ALWAYS MORE BINS

Finally, they had to put so ma bins in the factory to hold the resisto that there wasn't much more room le to make them.

Silly? Not a bit of it.

But what is silly is this:—

Resistors having a tolerance of p.c. and rated at 0.25 meg may exte in value down to 0.2 meg, while 0 meg resistors can range very close

0.25. Plenty of 0.2 meg resistors could actually be larger than others branded 0.25 meg, without going outside the said tolerance ratings.

Thus, a manufacturer could be officially out of stock of 0.25 meg resistors, while the adjacent bins were jammed with resistors well within the required tolerance spread but useless, because they had arbitrarily been branded with another set of colours.

So for any other group.

It might be argued, of course, that the practice of admitting such a wide tolerance is questionable; that resistors —and components generally for that matter—should be much closer to label.

The weakness of this argument is that it ignores the economic factor, as well as certain basic truths about radio circuit design.

THROW THEM AWAY?

In making components, manufacturers normally do try to keep them true to label, or as true as they can. But they have to cope with many vagaries of production and components often turn out higher or lower in value than intended.

To throw away these somewhat inaccurate components or to slow up the production rate to minimise risk of making them in the first place, could only result in a higher unit cost.

But the point is that there are plenty of positions in a receiver or amplifier circuit where a 20 p.c. tolerance on a resistor makes no noticeable difference to performance. Think of the various AVC and grid resistors, triode plate loads, decoupling circuits and so on.

To incur extra costs by demanding close tolerance components for these positions would be rather ridiculous.

It has been fairly commonly accepted throughout the industry that 20 p.c. is, in fact, a reasonable and acceptable tolerance on ordinary small components for such uncritical positions in a circuit. In fact, the industry can find use for a whole range of uncritical values.

From this, it is a simple step in logic to see that all resistors, for example, could be sorted into nominal values plus and minus 20 p.c., so spaced that their limits met but did not overlap. Further, that such grouping would minimise the number of values and obviate pointless overlapping.

NOT IDEAL

The old, arbitrary, "round number" system falls far short of the ideal.

For example, the ratio between 0.5 meg. and 1.0 meg. is so great that it leaves a gap in the middle and designers who were happy with neither limit really needed something in between.

But 0.75 meg. is too close to 1.0 meg., leading to some overlapping and duplication.

Similarly 0.25 meg. differs from 0.5 meg. by the same 2:1 ratio. But 0.3 meg., which was quite commonplace, is much too close to 0.25 meg., leading again to overlapping and duplication.

The International System of Preferred Values rationalises this position as a first step.

Starting again at say 1.0 megohm, the system recognises the fact that 20 p.c. tolerance resistors will go down to 0.8 meg. It also recognises that the next resistor value lower down the scale

Nominal Value	Res. Range
100,000——	80,000—120,000
150,000——	120,000—180,000
220,000——	176,000—264,000
330,000——	264,000—396,000
470,000——	376,000—564,000
680,000——	544,000—816,000
1.0 meg——	.080—1.20 meg
1.5 meg——	1.20—1.80 meg
2.2 meg——	1.76—2.64 meg
3.3 meg——	2.64—3.96 meg
4.7 meg——	3.76—5.64 meg
6.8 meg——	5.44—8.16 meg
10.0 meg——	8.00—12.0 meg

A few nominal resistor values and the spread envisaged by a 20 per cent tolerance. In practice, most resistors sold these days are 10 per cent or better.

should have a nominal value such that its upper tolerance coincides with 0.8 meg.

The required value works out at something less than 0.7 meg. By the same process, the next works out at just under 0.5 meg.

RANGE OF VALUES

In actual fact, to two significant figures, the agreed progression of values is 1.0, 0.68, 0.47, 0.33, 0.22, 0.15 and 0.1 meg.

Then it continues in the same progression: 68,000, 47,000, 33,000, 22,000, 15,000, 10,000, 6,800 and so on. In practice radio people are likely to be interested in values between 10 ohms and 10 megohms, and the above progression holds right through the range.

A few nominal values and the 20 p.c. tolerance limits which relate thereto, are shown in an accompanying panel.

Preferred Component Values		
20 p.c. Tolerance	10 p.c. Tolerance	5 p.c. Tolerance
10	10	10
		11
	12	12
		13
15	15	15
		16
	18	18
		20
22	22	22
		24
	27	27
		30
33	33	33
		36
	39	39
		43
47	47	47
		51
	56	56
		62
68	68	68
		75
	82	82
		91
100	100	100

This table shows the key numbers on the preferred series of values for 20 per cent, 10 per cent and 5 per cent tolerance. Television receivers draw heavily on the 10 per cent range.

From the manufacturer's viewpoint, the system minimises wastage, because every single resistor which he makes can be graded, if need be, into one bin or another, without transgressing the 20 p.c. maximum limits. And further, because the tolerances don't overlap to any extent, the theoretical minimum number of bins is required.

His stock position is simplified, and likewise that for everyone who uses the resistors.

Of course, the story cannot end there, because there are plenty of circuit positions in which a 20 p.c. tolerance could not be considered close enough and a 10 p.c. tolerance may have to be stipulated. Or, again, a 10 p.c. component may be required intermediate between the initially, rather widely spaced values which have just been nominated.

SYSTEM STILL HOLDS

But the system does not break down on this account. By nominating a new set of values at the points where the 20 p.c. regions just meet, the whole range breaks up into a sequence of values, so separated that 10 p.c. limits on those values just about coincide.

Thus, every resistor while a manufacturer makes can be grouped and branded, according to demand, in one of two ways:

(1) Into the more widely separated 20 p.c. preferred values;

(2) Into the more closely spaced 10 p.c. values.

In practice, the needs of the radio industry, particularly since the advent of television, have gravitated towards the 10 p.c. range. A fairly large proportion of circuit positions demand values accurate to within 10 p.c., while many others demand values intermediate between those originally specified and based on a 20 p.c. tolerance.

In line with this, resistor manufacturers are tending to guide their production into the 10 p.c. groupings and mark them accordingly. The industry is simultaneously coming to regard the 10 p.c. values as "standard." Thus, the figures specified in circuits and the resistors you buy over the counter, to put into those circuits, use "10 p.c." values freely and normally assume a 10 p.c. tolerance, unless otherwise specified.

TOO MANY VALUES?

Of course, you may argue that the resulting range in values is larger than your concept of the traditional "round figures." However, a little thought will show that, if the industry must now work to 10 p.c. tolerance and the intervals which this implies, the greatest economy must result from determining those intervals mathematically, in the way we have described.

Exactly the same thinking extends to the closer tolerance ranges. There are cases where the largest permissible tolerance on a resistor is 5 p.c.

It also follows that, if a circuit is as critical as all that, the optimum value may not coincide with a 10 p.c. interval at all but may need to be something in between.

To meet this need, the system has been broken up into nominal intervals based on 5 p.c. tolerances and the essential figures are shown in the accompanying table. Let's take an example, based on these figures.

2 ADDITIONAL Q-PLUS FIRSTS

★ A TRANSISTORISED 30W DC CONVERTER SUITABLE FOR 12V. D.C. MOBILE EQUIPMENT OPERATION.

ELEC. SPEC. [FULL LOAD CONDITIONS]

★ D.C. INPUT: 12V. @ 3A.
★ D.C. OUTPUT: 300V. @ 100mA.
★ RIPPLE: LESS THAN .5%.
★ EFFICIENCY: 80-85%.
★ DIMENSIONS: $3\frac{5}{8}$" LONG. $3\frac{1}{8}$" WIDE. $3\frac{1}{8}$" HIGH.

TRADE PRICE
£13/15/0
PLUS 12½% SALES TAX

★ A Q-PLUS 110° 14" TV KIT

COMPLETE WITH ALL VALVES INCLUDING PICTURE TUBE, SPEAKER, CABINET, AND EASY-TO-FOLLOW INSTRUCTION MANUAL.

NOTE THESE FEATURES:

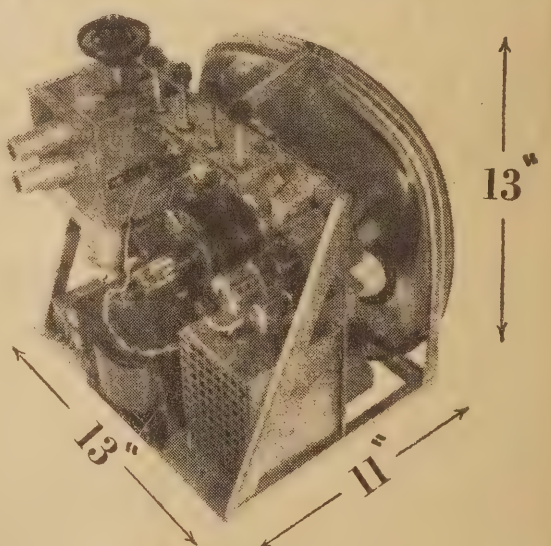
★ FULLY RATED AND SCREENED POWER TRANSFORMER UTILISING SILICON DIODE RECTIFIERS. (NO HOT CHASSIS).

★ FULL QUERY SERVICE AVAILABLE AT ALL TIMES

★ ONLY HIGHEST QUALITY COMPONENTS USED.

★ INCORPORATING LATEST CIRCUIT DESIGNS GIVING FULL PERFORMANCE WITH 14 VALVES & 2 GERMANIUM DIODES.

★ THIS KIT IS SUITABLE FOR CONSTRUCTION AS A 17" MODEL, WITH SMALL CIRCUIT MODIFICATIONS.



BUDGET PRICED AT 99 GNS. COMPLETE

NOTE: Complete technical specifications of all Q-plus products are available from

R. W. STEANE & Co. Pty. Ltd.

HEAD OFFICE & FACTORY: MELB. 2a Montrose St., Hawthorn E3. WB3377-8-9.
BRANCH OFFICE, SYDNEY: 8 CADOW ST., PYMBLE. JX3556.

AGENTS:

ADELAIDE	BRISBANE	PERTH
Wm. T. Matthews Ltd.	Keith Percy & Co. Pty. Ltd.	H. J. McQuillan P/L.
W7021	2-1757	BA8911

If a circuit calls for a 33K resistor in an uncritical position, it would be possible to use a 33K 20 p.c. resistor, because 33K is a value which occurs in the 20 p.c. range. However, you could equally well demand a 33K 10 p.c. component and, in fact, most 33K resistors you buy these days would be within this tolerance.

If you should want something still more accurate, a 5 pc. type would be ordered.

However, should the circuit call for a resistor, somewhat higher in value, there would be the choice of a 39K 10pc. type or a 36K, 39K or 43K, from the 5pc. range.

Logical, isn't it?

If you want to see a more complete listing of values, have a look at the advert. on page 124 of the last issue.

What of still more critical values? Say 2 pc or 1 pc?

MAY DRIFT

In practice, the tendency is to discourage supplying such orders with selected conventional carbon resistors. Even if such resistors are within tolerance at the time of selection, they may easily drift out of tolerance while in service, thereby negating the whole purpose of using them.

Thus, low tolerance resistors recommended these days are high-stability types, made quite differently from the ordinary component. Though often in short supply, the usual course is to stock them in all the values listed for the 5 pc range, plus other special values for which there is a known demand.

These would typically include 9900 ohms, 13,500, 250,000, 500,000, as so often used in multimeters.

Where a single critical value is not available, it is suggested that it be made up by connecting two other values in series or parallel, the assumption being that the cost of two such resistors would be far less than that of a specially made or selected "special".

Thus far, we have confined our remarks almost exclusively to resistors, for the simple reason that resistors pose the most obvious problem. But the same reasoning applies, in general, to capacitors and even to other specialised items like peaking chokes for TV receivers.

NOT SO CRITICAL

As far as capacitors are concerned, the main point of difference is that the tolerances are usually not so stringent.

There are, of course, positions, as in tone compensating circuits, where capacitance values are quite critical in terms of the end result. But these are well in the minority. For most applications, as for coupling circuits and bypass functions, the amount of capacitance doesn't matter much, except that there should be enough of it!

Thus, if the designer has been generous at the outset, a variation of plus and minus 20 pc. is of no great import. In fact, it is commonplace, these days, for capacitor manufacturers to be generous with their bypass units so that their ratings are for so many picofarads "minus nothing plus 100 pc."

to capacitors is not so critical, it is logi-

However, while the position in regard cal to allow the pattern of values to fall into line with those determined for resis-

Continued on page 117.

DISAGREE WITH STEREO ARTICLE

Dear Sir,

I should like to make some comment concerning an article "What to do about stereo speakers" which appeared in your magazine recently (August 1959). In that article the author purports to show that separate speakers are essential at all parts of the audible frequency range for the proper stereo effect. The reasoning presented is NOT valid.

After explaining that most sound sources have part of their spectrum above 300 c/s and part below, the author considers how a single woofer stereo system would reproduce such sound. He says that these sources will appear to "jump back and forth between the two sides of the room, depending upon whether it is playing above or below 300 c/s.

Nonsense!

Thus the effect will be that the sounds below 300 c/s do in fact come from one side of the room, we are not aware of them emanating from any particular point since there is no phase difference between the sounds arriving at our two ears (if the graph presented is correct).

Thus the effect will be that the range above 300 c/s will enable us to locate the sound, while that part below 300 c/s will not have any particular direction assignable to it.

This is just the way we would hear the real piano, so such a single woofer system could perfectly reproduce a sound in stereo, even though it be part above and part below 300 c/s (assuming the graph correct).

Now let us turn his comments on the experiment giving the graph (his fig. 2).

I fail to see how "entirely different data" could be given by any tremendous advance in instrumentation, but I certainly can see how different conclusions can be drawn. e.g. those of Mr Hoefler, which however, are regrettably false.

We can say that when there is no phase or loudness difference between sounds arriving at the two ears there can be no directional effect, and we see from the graph that this is so for all sounds below 300 c/s.

We cannot say that because there is a phase difference between the two ears, then there will be a directional effect, since hearing is a subjective phenomenon. Thus the experimenter was in no way contradicting his measurements when he remarked that it is difficult to locate sounds above 1000 c/s.

The "ludicrous syllogism" presented is quite valid. Thus if stereophony is only apparent between 300 and 1000 c/s then only for 20 per cent of the audible frequency range is sound stereophonic.

Now in the blindfold experiment how is the author to know that it is not the stereophonic 20 per cent of the sound which is enabling him to locate the drum, and that 20 per cent only, for he has already assured us that all instruments have part of their spectrum in the range 300-1000 c/s?

In fact the results of Dr Fletcher indicate that there is no need for separate speakers below 300 c/s, and if we take his subjective observation concerning higher frequencies at face value, then there is no need for separate speakers above 1000 c/s.

Please do not misunderstand me. I do not say that the above is the case. I merely say that if Dr Fletcher's results are applicable, then the above conclusion is true.

Yours sincerely,
G. G. (University of Adelaide).

Dear Sir,

Although my interest in stereo is (at the moment) theoretical only, I wish to draw your attention to seeming errors in deduction in the article by Mr Donald C. Hoefler in your August issue.

Mr Hoefler begins his argument with a statement of the theory which justifies the use of a single "woofer" in a stereo system — namely that at frequencies below 300 c/s, the human hearing system is essentially non-directional.

He then states that in a single woofer stereo system each instrument "will jump back and forth between the two sides of the room depending on whether it is playing above or below 300 cycles".

Your contributor should be able to see that, according to the above theory which he has not yet disproved for sounds below 300 cycles, he would not be able to determine the source of the sounds.

It would seem reasonable to assume that the changeover from directivity to non-directivity does not occur abruptly at 300 c/s as Mr Hoefler seems to think. Thus the sounds should gradually cease to have an apparent source as they approach this point, thus avoiding the illusion of instruments leaping around the room.

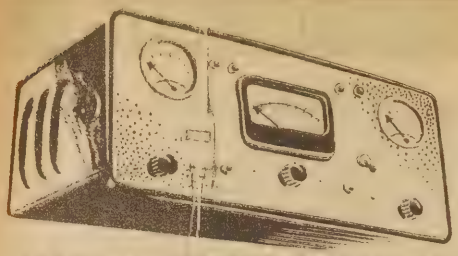
Now for the "two minute blindfold test". From my limited knowledge of musical instrument theory, I seem to recall the fact that most instruments, if not all, do not generate a single frequency tone but rather one with harmonics.

The presence of these harmonics at frequencies above 300 cycles would, I feel, explain the discrepancies between the "two minute blindfold test" and the tests caried out in the Bell Telephone Laboratories with the aid of "curves, graphs, tables, statistics and equations" and, I suspect, pure audio tones.

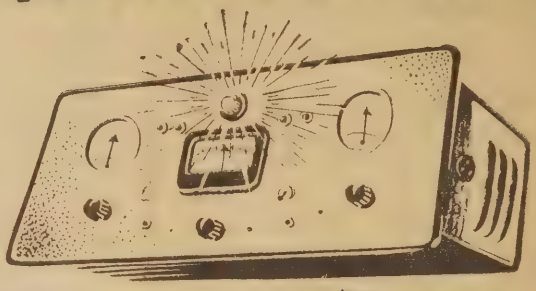
With congratulations for many excellent articles.

Yours faithfully,
D. W. N. (Nundah Q'ld.).

P.S. By the way, would three speakers in his three speaker system (fig. 3) be correctly matched as he states?



IS IT WORKING?



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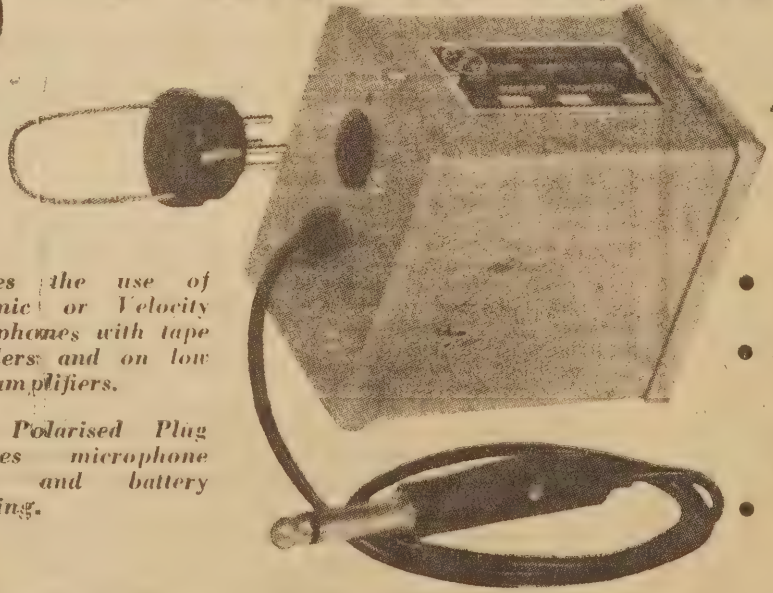

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OFF THE RECORD — NEWS & REVIEWS

Although my travels to date have not specifically included a study of disc spinning, it is quite apparent from walking the streets of numerous cities and towns that there is nothing like the interest in this part of the world that we see in England and America.

by John Moyle

NATURALLY the larger cities have the most record shops and the more elaborate stock and, no doubt, a native of each place would know better where to look. And, of course, both London and New York provide pretty heavy competition when it comes to such matters.

Here in Geneva I have found several smallish places in which classical records are mainly featured, including some labels I have not seen before and others, particularly Philips, which I have.

There is one, the most ambitious, which has quite an interesting collection of all kinds. American popular stars are well represented, along with European competitors. In Rome and Paris I saw most activity, for there is quite an audience in both cities. Vienna and Munich were apparently not so well stocked.

But the most noticeable lack was in the field of stereo. So far, the only stereo equipment I have sighted have been a few modest outfits in the larger shops, but virtually no enthusiasm in the selling of it. I do not remember seeing one stereo disc in a shop front, although, as I have said, possibly I didn't know the best places to go.

But it is my habit to walk my shoes off in a new place, and I certainly couldn't do that in the main streets of Sydney without numerous invitations to buy, issued both by enthusiastic printed words and by demonstrations of numerous stereo players.

"STEREO" JUKE BOX

Oddly enough, the first cafe in which I ate a meal at Geneva had in the corner a most glamorous juke box announcing in chromium letters that it was stereo! As it looked like any other juke box I don't quite see where the stereo came in, although possibly one can't be too particular about the veracities when juke boxes are concerned.

The place was too crowded for me to invest 20 francs to find out and I haven't been back there since.

But my impression is that Europeans, except perhaps the ever-present devotees who are hidden in the suburbia or its equivalent in every city, hasn't yet "gone stereo" to any degree. Maybe the reason is that the standard of living is not so good or perhaps just different, which apparently accounts for the further fact that TV hasn't made a fraction of the pace it has elsewhere, and certainly not comparable in any way with that in Australia.

Musically, Europe is a paradise if one knows where to go and happens to be in the right place. Geneva is the home of the Suisse Romande Orchestra with its famous conductor, Ansermet, and, judging from the concerts being given —alas, anywhere so far but in Geneva —it is a hard-working body.

I note that it is due to commence a series of concerts in the Victoria Hall in the next few weeks, just when I will be thinking about coming home.

I had a ticket for the first concert I have been able to find in this city but, unfortunately, there was an important conference meeting which cropped up to clash with it at the last moment. So I missed the Beethoven 4th,, a Chopin concerto and some Ravel, the name of which I have forgotten.

Such is the penalty of being conscientious!

NOTHING IN PARIS

Nevertheless the Suisse Romande has featured in a number of broadcast concerts from other Swiss centres and these I have heard from time to time with famous soloists.

There was nothing to hear in Paris during a weekend visit, but the story was different in Vienna, where I spent another weekend in my effort to make the most of whatever spare time I have been able to arrange. Unfortunately, the tempo of work in recent weeks has invaded even the traditional weekly break, which is both frustrating and tiring.

Vienna has an impressive collection of concert halls and theatres large and small, the most famous of which are the Wiener Staatsoper and the Konzerthaus. The former is the home of the Vienna State Opera, and the latter one of the great concert halls of Europe, where the Vienna Symphony and Vienna Philharmonic Orchestras perform, all of which are well known to record lovers all over the world.

The Konzerthaus was apparently undamaged during World War II, but the Opera House was completely destroyed and has now been rebuilt almost exactly as it was in the days of its past glory.

FULLY RESTORED

Even the beautiful salons where the audience promenades at intervals are restored, with their painted ceilings and elaborate ornamentation. The marble staircase in the foyer and the statues which stand up under the chandeliers are there again, although I gather that the very modern treatment of two other salons and the general appointment, which are first-class, owe their design to modern times.

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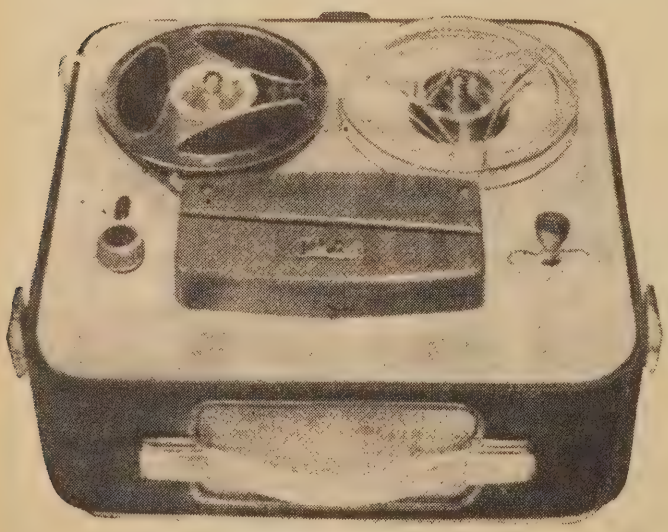

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domed roof, is magnificent in its new dress, and better acoustic treatment and splendid and ingenious ventilation make it a delight for its patrons.

It has five galleries reaching to the roof level, three of them made up of "boxes" holding eight or 10 people and extending right to the edges of the proscenium, something like those of la Scala which, however, has six tiers and is, I think, somewhat larger. At Vienna a seating capacity of 2,200 is claimed, but a rough count made me wonder just where all these would fit in!

At the rear of the ground floor there is a standing area much patronised by the youth of the city, who line up at the doors early in the evening just as they do at home. In contrast to Italy, where most evening performances seem to start about 9 p.m., the opera commences at 7.30 so that everybody starts for home about 10.30 p.m.

HIGHEST STANDARD

The standard of performance I found the very highest. The settings are most elaborate and impressive as might be expected of a stage claimed to be the deepest in the world, although possibly not as magnificent, as yet, at any rate, as those of Milan or Paris.

But the cast, apparently based on an exodus from la Scala, reads like the line-up of a Decca recording album.

A performance of the Masked Ball by Verdi, which is a very popular opera in Europe, included Guiseppe di Stefano (tenor), Ettore Bastianini (baritone), Birgit Nilsson (soprano) and Erika Koth (soprano).

Di Stefano sounds every bit as good as he does on records, as one might expect from probably the leading Italian tenor of the day, although his powerful upper register does come perilously near to a shout, perhaps the result of the huge number of performances he gives.

I noticed that, on his next scheduled performance, he was replaced by an understudy on the score of ill-health, so possibly my impression may have some firm grounds.

Bastianini I thought one of the finest and most reliable baritones I have ever heard. His main arias were quite magnificent, and he received one of the biggest ovations I have ever heard, holding up the show for a good five minutes while the audience clapped and stamped and made encouraging cries in German.

FAN CLUB?

Being a very handsome and engaging personality, he was particularly in favour with the juvenile members of the fair sex, who seemed to have some kind of a fan club in action.

The conductor, incidentally was Lovrov Matacic, a Czechoslovakian musician also well known in the recording world.

Traviata had as its star Hilde Gueden, as famous a recording star as any. Although not as consistently powerful as Nilsson, she was a most engaging Violetta. In fact I would not have believed that the melodramatic masterpiece of Verdi could have been transformed into such a moving thing as she made it.

Despite my dismay at the poor standards of medicine and nursing which allowed a woman dying of consumption (I presume) to get out of bed in her nightie, aided and abetted by her attendants and advisers, and reach her pathetic end without even the comfort of a hot-water bottle, I found myself almost as upset as her distracted lover, a man outweighing her by about 8st!

And as, after all, that was Verdi's whole intention, I judged she really deserved the plaudits of the audience. In my case it was largely in relief that after all she was still very much and charmingly alive, that I also put my hands together from my position in the "Royal Box." (I was lucky enough to buy a ticket from some unfortunate who apparently had been faced with an unforeseen emergency which prevented him from using it.)

And to make me even more reluctant to catch my early plane next morning back to Geneva, I noted as I left the theatre that Renata Tebaldi and Bastianini were billed to play Tosca on the following night.

Those Viennese certainly know how to stage an opera.

I only wish those who are planning our curiously designed "opera house" would sort out their ideas in such a manner concerning the difference between an opera house with its peculiar acoustic needs and those of a concert hall. Those five galleries and a ground floor capacity of about 500 aren't made that way for nothing.

But that's another story.

VIENNA KONZERTHAUS

I didn't hear the Vienna Orchestras whose season had not begun, although the State Opera Orchestra was a completely worthy substitute. But, I did make my way into the Konzerthaus just to see what it was like; finding the doors open on a Saturday afternoon and some cleaners at work I'm afraid I just walked in and had a look. No one seemed to mind and I just pretended I belonged there!

There is a huge reception hall under the auditorium which is reached by a wide staircase at one side, and in it is a large replica of a famous statue of the seated Beethoven, the original of which is in a public park near by.

The outside of the Konzerthaus isn't very impressive and the inside is just about due for a good cleanup, but the auditorium is very large and in the traditional style with a balcony along the sides and the rear.

Despite this it avoids the sin of our own Sydney Town Hall with its atrociously high ceiling, and judging from its reverberation constant when empty it should sound very well. Fortunately no one saw the madman tramping the floor and clapping his hands in the approved manner to test the acoustics!

But I weep for the man who has to creep in late, if ever such a thing were allowed. The wood block floor has developed a spring and a family of squeaks and groans I am sure the builders did not intend!

MUSICAL HISTORY

Apart from opera and halls, I found time to hunt out some of the spots made famous by musical history, with which the Vienna of Brahms, Beethoven, Schubert, Mozart, Dvorak and so many others abounds.

One I won't forget is the little bare room, about 12ft x 6ft, in which Schubert died, almost penniless, in 1826. I went into the small courtyard where no doubt the horses and various vehicles parked themselves in those days, and climbed two flights of stone stairs to get there.

(Continued on Page 107)

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I.R.C. advertisement which appeared in the October issue. Attention is drawn to readers that the incorrect 'phone number appeared in that issue. The correct 'phone number is BX1131.

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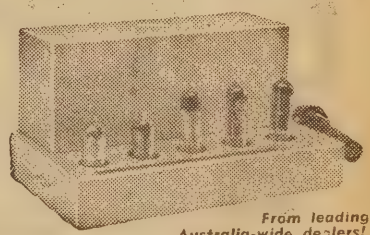

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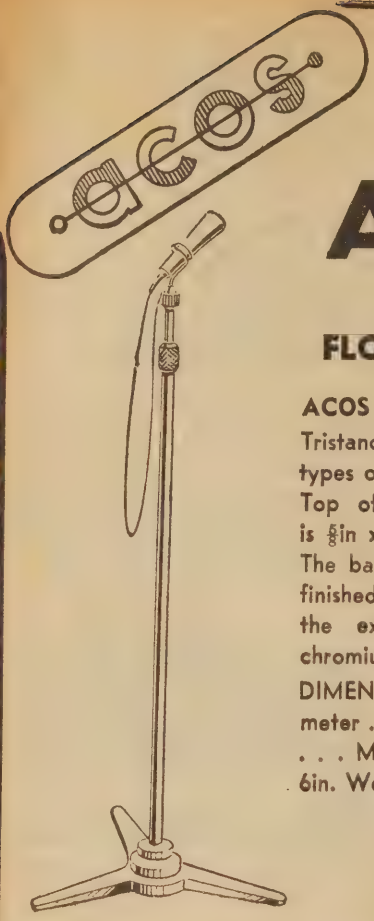

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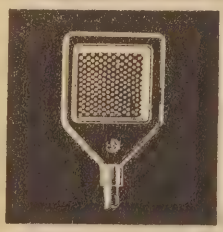

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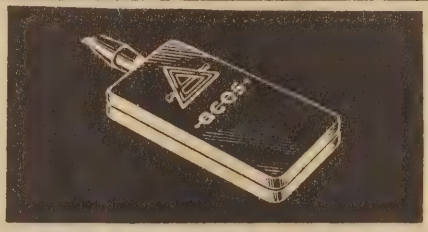

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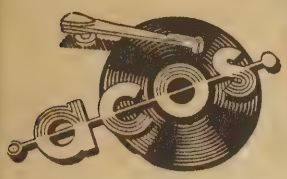

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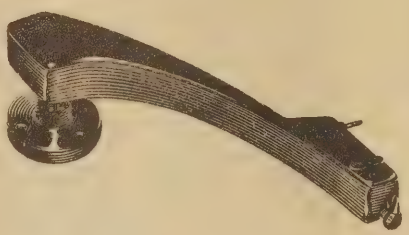

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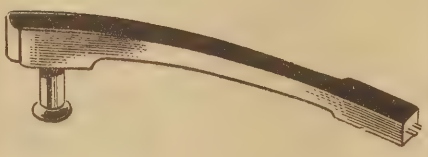

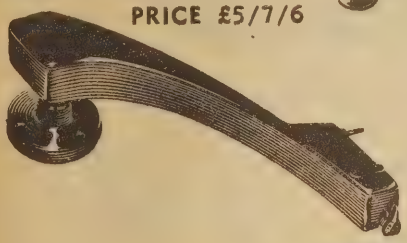

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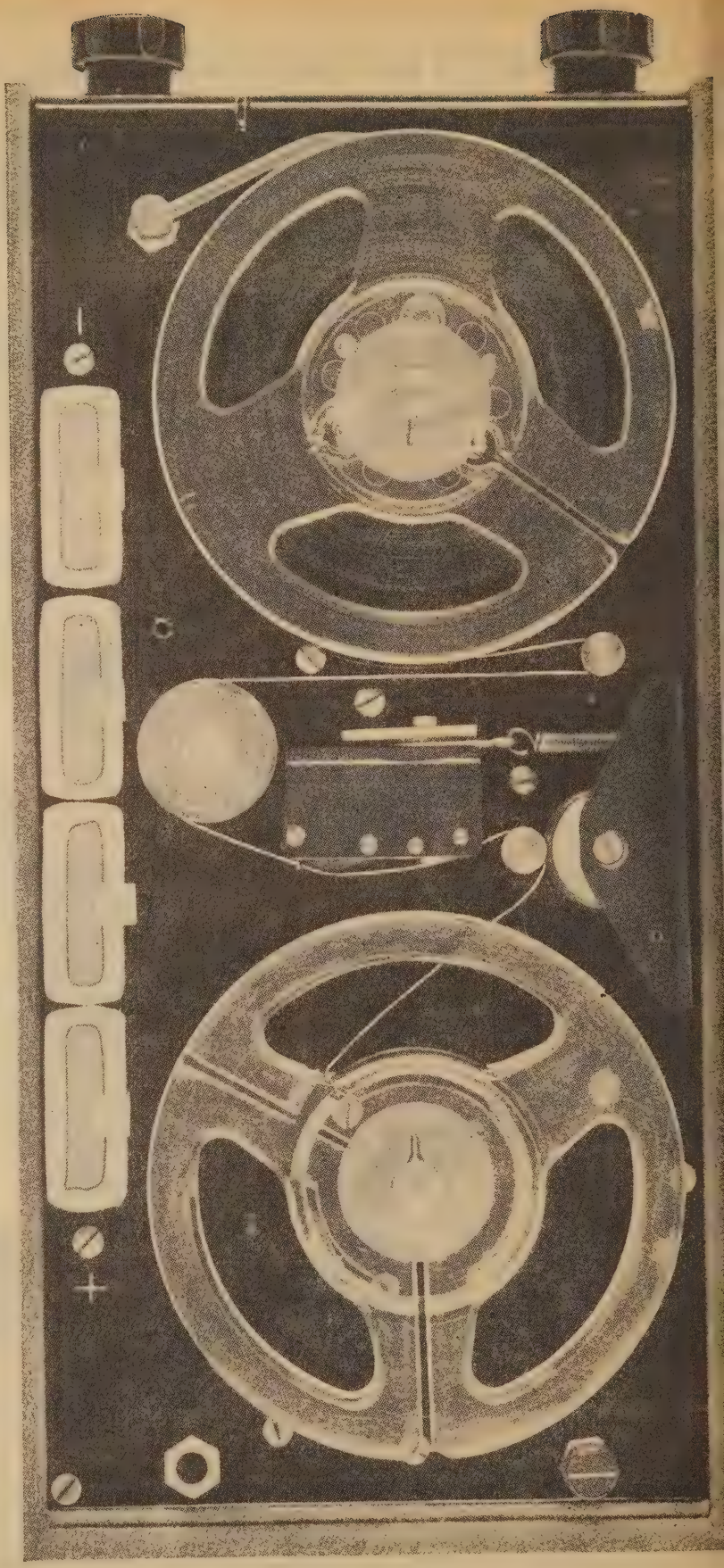

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OFF THE RECORD—Continued

The old dame who let me in showed me the few relics of Schubert which are there—some pictures, photographs and scores. And sat patiently at the door until I paid my schilling and came away. Which I did, descending the steps Schubert had himself climbed for the last time, and feeling, as no doubt hundreds of others had, too, a special moment of sadness that this most lovable and loved of all musicians had so short a while to walk these streets of Vienna and write the songs we will always sing.

I am still hopeful that I will have time to return through England and America, where I may be able to snatch a quick look at what is happening there. I am sure that, in the recording world at least, I will find much more activity. And if I am lucky, I may strike a performance of the famous Metropolitan Opera in New York before they begin to wreck it in favour of a new building. It is just about the last I have to visit to make up the grand slam.

RECORD REVIEWS

MASCAGNI — Cavalleria Rusticana, with Beniamino Gigli, Bruna Rasa, Giulietta Simionato, Gino Bechi, Maria Marucci and La Scala Orchestra and Chorus conducted by Pietro Mascagni. Recorded in 1940. LEONCAVALLO—I Pagliacci with Beniamino Gigli, Iva Pacetti, Mario Basiola, Giuseppe Nessi, Leone Paci, Arnaldo Borghi, and La Scala Orchestra and Chorus conducted by Frano Ghione. Recorded in 1934 HMV OALP 1610-1612. With full Libretto.

Both these recordings can be classed as historical, and have no doubt been issued to provide a long-playing edition of performances which were famous in their day both for the singers and their interpretation.

In point of fact, Gigli is the only one of the performers whose name has survived as an operatic tradition or who contributed anything lasting to the roles represented.

Mascagni himself conducts his opera, and even speaks a few words at the commencement of the disc, which add to its value.

Of the two recordings I am most familiar with Pagliacci, and have always kept the original 78s for their own virtues as well as their ancient origin.

Playing them through in the LP form I could detect all the odd features of the various sides, even to characteristics of the surface noise which are all reproduced more or less clearly.

And despite the fact that Pagliacci was originally recorded in July, 1934, it is remarkable how well the lines of age have been removed or avoided.

I don't remember any unfortunate incidents in the sound in either opera, and mostly the voices are perfectly clean and clear.

To the super-critical, a few are a little oppressive in their louder moments, due no doubt to the close miking, and perhaps a rise in the mid range but these are details.

The orchestra hasn't as much clarity, definition, or dramatic impact as the latest recordings but it is by no means anaemic. It has a good body and its general tone is better than you would anticipate. Once we thought it terrific!

The surface noise can be heard, but it is in the form of a steady and unobtrusive hiss which almost makes me think a little has been added to make certain of its constancy, or else the material from which the dub-discs were made has this quality.

And although there isn't the same frequency or dynamic range as on the latest Columbia recording with Callas and Stefano, I was most pleasantly surprised to note how soon I got used to the older type sound, and how well it has been preserved.

One can notice a better all-round standard in Cavalleria Rusticana, the younger by six years.

The performances of today are much more direct and dramatic, aided no doubt by the greater immediacy of the recording, but owing just as much to a different technique.

For instance the Columbia sets of recent vintage both have Callas as the soprano and Stefano as the tenor, both singers with few inhibitions, particularly Callas.

But the earlier recordings, despite their vigour and animation, give us grand opera in the more classic style, they both owe more to the past than to the future.

They may be less rugged, but from Gigli at least there is more beautiful singing.

He is the star and his performances are impeccable examples of those which ruled the European stage after the death of Caruso.

There is no tenor singing today who can match the effortless ease and beauty of Gigli.

Neither soprano is as good as Callas in her roles, although she has many weak points as a recording artist. I was always luke-warm about the early Nedda, whose worst moment comes at the end of her love duet with Silvio in the first Act.

On the other hand, Callas has moments just as unconvincing, but her high spots are truly magnificent.

Direct comparisons in detail, however, are rather pointless, as most people who buy this new Album will do so to obtain two very fine performances on only three discs which, despite their age, show up remarkably well and which have a musical value peculiarly their own.

I enjoyed every note.

★ ★ ★

BEETHOVEN—Symphony No. 2 in D major Opus 36 — Incidental Music to the Ruins of Athens. Played by the Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. HMV 1596.

I was immediately struck with the brightness of the sound in this typically Beecham version of the Second.

In this it contrasts with most other recordings which have more apparent bass but which are by comparison duller and less clearly articulated.

As a matter of fact the closer attention to the upper end of the scale is more typical of some other labels than of HMV, and I would not have picked the label merely by listening to it.

The bass could have been strengthened without in any way detracting from the

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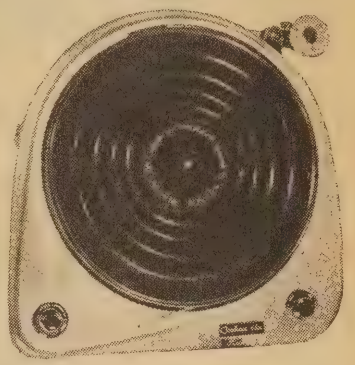

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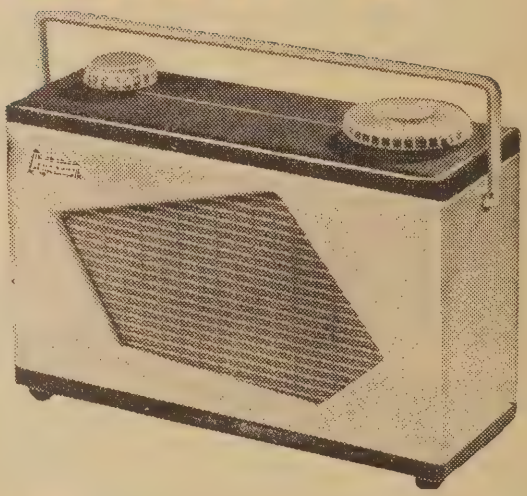

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ecord's clarity which I found most re-reshing. By clarity I mean specifically larity of instruments and voices which re well defined.

But on the whole I accept the balance s very satisfactory with a quality I ould describe as refreshing. There are everal very good recordings of this ymphony, but I like this one as well s any from this point of view.

Beecham hasn't delved very deeply nto the symphony, although it doesn't ike kindly to overweight.

His graceful touch is there, and the aultlessly moulded phrasing makes all is tempos seem just right.

One thing I always like about Bee-ham performances is that the orches-ras, no matter what their class or ationality, always seem to give of their est for him.

To be super-critical I wouldn't say he playing has a quality as faultless or ven as polished as some of the very est, but it is always responsive and deft nd I'm sure you will like it.

In the total scoring I would place it mong the best there are.

The Ruins of Athens music is a wel-ome change from the usual parade of oriolans and Leonoras, and most will ate it as strong in its appeal as the ymphony itself.

The choral work is by the Beecham horal Society.

The surface can be heard, but only ust, and it is free from clicks and such-ike—its very faint and consistent char-cter can easily be ignored.

★ ★ ★

VERDI—La Traviata, with Maria Stader, Ernst Haeflinger, and Law-rence Winters, with the Choir and Orchestra des NDR, conducted by Hans Schmidt-Isserstedt. DGG 136005 ST33 SLPEM (Stereo).

An abridged version of the opera with strong cast and some extremely fine inging.

It includes all the highlights, and there re possibly more fine and musical arias n Traviata than in any other opera.

Most of the burden is carried by Maria Stader, and she acquits herself at mes magnificently.

It is a role to make demands on any oice in its long and florid arias.

It needs considerable dramatic qual-ies as well, for there is plenty of high-owered emotion.

If she has a weakness, it is a difficulty n singing her upper register quietly. A ghter timbre would have been better ere, but this is a minor criticism, and ne is not alone in this.

Ernst Haeflinger is also happier in the nore robust passages.

Against this, there is a splendid Ger-ont and some very fine concerted sing-ng.

Quality deteriorates a little near the nd of the second side on my copy, but nly wide-range equipment may extract nis.

The orchestra is very good through-ut, and I liked the general balance.

The stereo does not rely very much on eparation, but is of a more subtle kind, iving body and atmosphere throughout, hich is quite appropriate to the occa-on. Any suggestion of stunting would ave detracted greatly from the general ffect.

The surface is quite good. The aver-ge amplitude of cut isn't high by latest andard, although judging from the ound it would have been unwise to have increased it, for mostly the voices are quite closely miked.

The record comes in an attractive folder with text in German.

★ ★ ★

BOSTON TEA PARTY—Moon-glow and Theme from Picnic, Her-nando's Hideaway, Fantasia on Greensleeves. Played by the Boston Pops Orchestra, conducted by Arthur Fiedler. RCO S20208 (Stereo).

It was only a matter of time before stereo discs became available in the 45 speed, and RCA have now broken the ice with several.

This one presents well-known tunes by an orchestra and conductor both of whom specialise in such things.

The playing is pleasant and practised, but I would not say technically it is quite as good as the larger discs, or at least the best of them.

I have a feeling that the top end has been lifted to compensate for a radius effect. I found this record sounded better with some top cut, which also reduced what seems to be tape hiss.

The stereo spreads well, and a switch to mono will clearly illustrate what it does for the music.

I hope we see many more stereo discs of the smaller size, for good recordings in less expensive form will do much to stimulate the general growth of stereo.

More, please, RCA.

★ ★ ★

STRINGS BY STARLIGHT — Borodin Nocturne, Bach Air for G String, Tchaikowsky Waltz from Serenade for Strings, Londonderry Air, Tchaikowsky Andante Canta-bile, Barber Adagio for Strings. Played by the Hollywood Bowl Symphony Orchestra, conducted by Felix Slatkin. Capitol P-8444.

Every one of these numbers is a winner in the string orchestra field.

Five of them are lavishly endowed with long, melodious and sustained pas-sages, which are so kind to the strings, easy on the ears, and soothing to the nerves.

The Tchaikowsky Waltz is brighter, but no less attractive, and I'd have been just as happy to have heard more from this Serenade.

The Hollywood Bowl strings are well-versed in the art of producing beautifully controlled tones, with well-graded cres-cendos and effective dynamics. The Lon-donderry Air and Adagio for Strings are possibly their best efforts.

But, although their playing will un-doubtedly meet with general approval, they do suffer from lack of variety and individual character.

There is a big difference between Bach and Tchaikowsky, but you wouldn't think so from the examples played here.

But if these are matters for the musi-cal pedant, they are unlikely to worry unduly one who just wants to listen.

And, after all, this is obviously the aim of the record.

The recording is smooth, rather than brilliant. It has a well-judged and firm bass, but the strings sound rather middly, as though their extreme top had been lopped off. This could be, for they are closely miked in a fairly reverberant chamber — at least, this reverberation is heard on occasions which could scarcely have been produced from out under the stars.

The surface is fair, but not first-class.

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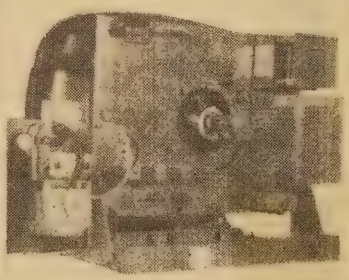

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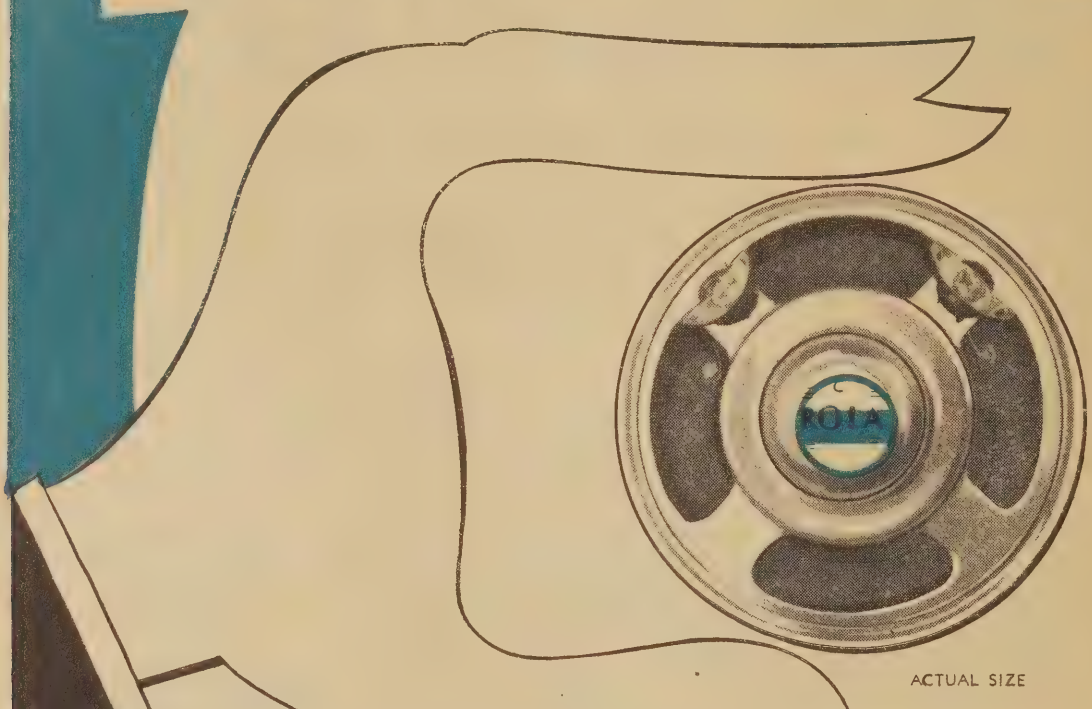

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TECHNICAL BOOK REVIEW

HI-FI SERVICE

THE PRACTICAL HI-FI HAND-OOK, by Gordon J. King, Assoc. Brit. R.E., published by Odhams Press Ltd., ondon. Hard cover, 224 pages, 9in by in. good quality paper. Illustrated by umerous photographs, line drawings and ircuits.

From its beginning as the realm of a ew technical and musical enthusiasts, uality audio systems have now come o take up a large proportion of the otal home entertainment time. Many f the owners of these systems have a een appreciation of music and a sensi- ve ear for distortion, but are almost elpless when it comes to effecting re- airs.

Out of this situation there arises a ompletely new field for electronic ser- icemen who are willing to attend to ne minute faults of these highly strung quipments and, more important still, illing to listen sympathetically to their wners.

Mr King would appear to have had xperience in this field and his book is imed mainly at assisting the serviceman, lthough it would also be of value to the echnically minded amateur enthusiast.

A useful and up-to-date description of ll the components of a high fidelity ystem makes up the major part of the ook with emphasis of procedures for nding and clearing faults. A final chap- er on stereophony brings the work right p to date.

Our copy direct from the publisher. No Australian price is available. How- ver, the English price is 25/ (M.V.F.)

TAPE RECORDING

MAGNETIC SOUND RECORDING, y D. A. Snell. Philips Technical Lib- ary, 1959. Hard covers, 217 pages. Good quality paper, freely illustrated y photographs and drawings.

This book may fairly be described as descriptive" in character, with tape ecorders and tape recording as its heme. It is not heavily technical but s apparently aimed at imparting useful, asy-to-read information on the subject o technicians and advanced hi-fi en- husiasts.

The book begins with a fairly brief urvey of sound, its character and ttempts to record it on wire, film and ape.

It then progresses to a more de- ailed and probably more useful explana- ion of magnetic phenomena and the rocess of magnetisation, particularly as applies to tape recording.

This leads naturally into an examina- ion of magnetic recording heads, and rase functions. There is a chapter on ecording tape and another on recorder rive systems.

Amplifiers, loudspeakers, microphones re discussed in turn.

Thereafter the book turns to practical ecording and playback, mainly from he amateur as opposed to the profes- ional viewpoint. It has something to say bout stereophonic systems, the use of tape with sub-standard films and lists a variety of possible uses for tape equip- ment.

In other words, if you want general technical background information on tape recording, you will find this book very useful and easy to read. But, if you want heavy meat on the subject, with plenty of circuits and designs, look for something more advanced.

Our copy from the publishers. Aus- tralian price is quoted as £1/10/.

CIRCUIT THEORY

RADIO CIRCUITS: A Step-by-Step Survey. Fourth Edition. By W. E. Miller, M.A. (Cantab.), M.Brit.I.R.E. Revised by E. A. W. Spreadbury, M.Brit.I.R.E., Associate Editor of "Wireless and Electrical Trader." Pub- lished by Iliffe and Sons Ltd., May, 1959. 172 pages, including 84 diagrams in the text, and 2 foldouts.

This book is almost an "evergreen" nowadays, having been first published in 1941. A second edition appeared in 1942, followed by a third in 1951, and now the fourth in 1959.

The latest follows closely the style of the earlier editions but the contents have been brought up to date to include car receivers, transistor circuits and frequency modulation.

To read through the index is like progressing through the various stages of a typical superhet. receiver. Thus we have "Superhet. Principles," "Aerial Input Circuit," "Tuned Input Stage," "Band-Pass Coupling" and so on, right through to "Class B AF Coupling," "AC Power Supplies" and "AC/DC Power Supplies."

To mention just a few more, there are chapters on negative feedback, gramo- phone reproduction, car radio, FM re- receivers and combined AM/FM re- ceivers.

The book would provide excellent reading for those who have built a few receivers and amplifiers but want to know more about how and why they work. A particular advantage is that the chapters are self-contained, so that reading can progress a few pages at a time, without depending too heavily on what has gone before or what has yet to follow.

Our copy direct from the publishers.

AUDIO TESTING

AUDIO MEASUREMENTS, by Norman H. Crowhurst. Stiff paper cover, 224 pages, freely illustrated with photo- graphs and diagrams. Gernsback Library No. 73. American price quoted as $2.90.

Norman H. Crowhurst is well known and respected as a writer of articles, mainly on audio, in American technical magazines. He has a reputation for clarity of expression, accuracy and sound common sense.

The contents of this book are at about the same technical level and well suited to advanced "audiophiles," technicians or servicemen who may have ideas about specialising in audio work. At this level, it will serve the multiple roles of good reading, a text book and a reference book.

The first three chapters cover the sub- jects of "Measurement Techniques," "Test Equipment" and "Basic Measure- ments." The emphasis is on aim, method and limitations and this section carries many illustrations of typical commercial test equipment.

Chapters 4, 5 and 6 are devoted to basic amplifiers, output transformers and preamplifiers, in that order.

Then follow other chapters on ancil- lary gear, notably pickups, turntables, tape systems and microphones. All these chapters contain a great deal of interest- ing and very practical reading.

You will look in vain, however, for material on loudspeakers, dividing net- works and baffle systems. The author explaining this, says that so much has been collected concerning the "electrical" side of audio that there is simply not room in a volume of the requisite size to include all that can and should be said about the "acoustic" aspects. Separate treatment is warranted.

He is probably right. One thing is certain: if you are interested in the opera- tion of audio equipment, you will gain a great deal of pleasure and profit from this book.

FREE LEAFLETS

A data chart for AWV transistors has just been issued by the Amalgamated Wireless Valve Co. Pty. Ltd., of 47 York Street, Sydney.

Printed in three colours, it lists the AWV range, indicating maximum ratings characteristics and physical details. A quick reference chart on the back page indicates which transistors are suitable for what roles.

A second free item is the booklet entitled "How's Your Television I.Q.?" It is intended to answer some of the questions commonly asked by members of the public, relative to television.

Copies of either or both items are available free on request to the Amalga- mated Wireless Valve Co., at the address noted above.

SHORT-WAVE NOTES BY ART CUSHEN

31 GOSPEL BROADCASTS SOON IN SERVICE

An increase to 31 in the network of gospel broadcasters will enable this missionary radio to encircle the world, when ten more, now under construction take the air shortly.

IN a recent interview with Dr Clarence W. Jones, the co-founder of HCJB in Quito, Ecuador, the latest news on stations in all continents showed the growth of this type of broadcasting.

Dr Jones was on a fact-finding tour of the world, inquiring into the impact of missionary radio and, when in New Zealand, was able to tell us first hand of programs in this work, which he started in 1932 with the first broadcast of HCJB.

In Liberia the work of ELWA is to be extended and, in Ethiopia, a new missionary radio is under construction. In Switzerland a new station, "Radio Revival" is under construction and has now commenced its new broadcasts.

Okinawa is the site of new 100,000 watt transmitters for the Far East Broadcasting Company, which are now being installed while, in Manila, at the headquarters of FEBC, the 50Kw transmitters are providing excellent signals throughout East Asia.

The Quito station, HCJB, is now to install new hydro-generating plant to help meet the increasing use of power associated with the high-power 50 Kw transmitters of HCJB. This station is now broadcasting 24 hours a day.

The present missionary radio stations in operation now total 21 and, with the ten new installations now under construction, the total will rise to 31 early next year.

HLK52 ON 6035 Kc.

RECEPTION of the new outlet of the Voice of Free Korea in Seoul has been received on 6035 Kc., as this country has now reverted to Standard Time. HLK52 has in the past few months operated on two other frequencies, but its reception on 6035 Kc. with its English transmission has not been possible here as, in the past, the station for this period was covered by Radio Noumea in New Caledonia.

The English broadcast from Seoul is heard from 8.30 p.m. to 9.00 p.m. and consists of news, commentary and musical items. The broadcast is also released on 9640 Kc. at the same time and this higher frequency gives much the better signals. The 6035 Kc. station has little interference after Noumea leaves the air at 8.30 p.m., giving almost interference-free reception of the South Korean station.

SERVICE FROM KENYA

ON October 1st the stations in Kenya became known as the Kenya Broadcasting Service, P.O. Box 621, Nairobi. The stations operate in the English national service, on 4885 and 7240 Kc. 10kw. Monday to Friday, 1.00 to 3.30 p.m., 7.15 to 9.15 p.m. and 11.00 p.m. to 6.00 a.m.; Saturday, 1.00 to 3.30 p.m. 7.15 p.m. to 6.00 a.m. Mondays the sign-off time is 5.30 a.m.

The African service is on 4934, 7410 Kc. 10 Kw weekdays, 1.30 to 2.30 p.m.; 7.30 to 9.00 p.m., and 12.30 a.m. to 6.00 a.m. Sunday the transmission is 2.00 p.m. to 9.00 p.m. and 12.30 a.m. to 5.00 a.m.

The Asian National service is on 4855 Kc. and 7150 Kc. 6Kw. 1.30 to 3.00 p.m., 8.00 to 9.00 p.m., 1.00 to 6.00 a.m. Monday sign-off is 5.30 a.m.

Mombasa Regional station is on 4965 and 7180 Kc. 5Kw. Weekdays, 1.30 to 2.45 p.m., 7.30 to 8.30 p.m and 1.00 to 7.00 a.m.

Kisuma Regional West Kenya station is on 4804 Kc., 7288 Kc., 5Kw. Weekdays, 1.30 to 2.45 p.m., 7.30 to 8.30 p.m., and 11.00 p.m. to 4.15 a.m. An African regional service from Nairobi is on two provisional short-wave transmitters 4760 and 7125 Kc. with 6Kw.

KUWAIT station has dropped in frequency to 4967 Kc., and is on the air from 2.00 to 5.30 a.m. The power at present is 1Kw., but this will soon be increased to 5Kw. All programs are in Arabic with news at 3.00 a.m. The station now verifies with a card.

NEW STATIONS FOR GERMANY

NEW stations and additions to the transmitting facilities of stations in both West and East Germany have been announced. This news, from Japan, indicates that the Deutche Well station at Cologne in 1960 will add two further 100 Kw. transmitters to its broadcasting schedule. The new wing to house these two transmitters has been completed, and they will be installed mainly to give better signals in India and Central America. New 300-feet towers are also being erected. These when installed will bring the number of towers to carry the intricate aerial systems to 28.

In East Germany, the Ministry of Post and Telecommunications, a modern high frequency station is to be started this year. The present short-wave transmitter at Leipzig is to be replaced by a transmitter on higher power feeding a rotatable antenna. Nine short-wave transmitters are to be installed at Leipzig.

A VERIFICATION letter, pennant and p card were received recently from Ra Gazeta, in Sao Paulo, Brazil. The verificat came from the Director of Broadcasting of station. The address is Edificio Gazeta, Av. C per Libero 88, Sao Paulo. The station uses th short-wave transmitters, ZYR225 on 5965 k ZYR227 on 9685 Kc. and ZYR228 on 15325 k

Another verification received is from Ra Liberation, in Munich. This station uses f quencies of 3990, 9565, 9730, 11965, 11935, 153 15370, 15410, 17730, 17765 and 17865 Kc. T verification from Radio Liberation is from Da enstiftstr 5, Munich 2, Germany.

FLASHES FROM EVERYWHERE

MARTINIQUE is reported from North America as being heard on 5994 Kc. with the broadcasts originating from Fort-de-France. This station was for many years in the 31-metre band and in the early 1940s was heard from time to time during the winter months. The new frequency is in the mornings and the present broadcasting schedule is from Monday to Friday from 6.30 to 11.15 a.m., Saturday, Sunday from 6.00 a.m. to noon.

LISBON station, Radio Nacional, on 21,495 and 17,880 Kc., is being heard with English news at 11.45 p.m. Light music follows this news release and is heard to 12.30 a.m., at which time the station concludes this transmission, which is beamed to the Far East.

TURKEY is reported to be using the new frequency of 9745 Kc., when it commences its English broadcast to the British Isles at 7.00 a.m. The frequency of 15,160 Kc. is the best received in this broadcast from Ankara.

VIENNA continues its test transmissions on short-wave and recently its frequency of 9665 Kc. has been noted to have moved to 9670 Kc. The station has been observed from 5.00 p.m. to 7.00 a.m., with relays of the normal home program of Radio Wien. It is understood the change in frequency has been made to avoid the interference from Berne, Switzerland, which also is using 9665 Kc. for part of this transmission period.

NEW YORK station WRUL, which has a special daily transmission to Europe, is on the air daily from 6.00 to 7.15 a.m. from Tuesday to Saturday, 5.30 to 7.00 a.m. on Sunday, and from 5.00 to 8.00 a.m. on Monday. The station uses the frequencies of 17,755 , 21,460 Kc.

MONROVIA station ELWA, broadcasting from Liberia, has been observed using French at 3.00 p.m. on the frequency 11,985 Kc. This station also has been heard during the late afternoons when they open at 4.45 p.m. on 4770 Kc.

> Notes from readers and requests for information on short wave stations should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Australian Eastern Time.

TANGIER station Radio Inter-Africa now comes on the air at 9.00 p.m. and, for the following six hours, relays the medium-wave station, Radio Africa. The station is now using 15,285 Kc., which has been put into service since the station abandoned 14,880 Kc. From 4.30 to 8.30 a.m. the station is again in service, broadcasting on 15,285 Kc.

AFGHANISTAN station, Radio Kabul, has now extended its transmissions with a new service on the 19-metre band frequency of 15,385 Kc. The station is on the air from 3.00 to 4.00 a.m. on the 15,385 Kc. channel, but reports from Europe state interference from Moscow on the same frequency is severe.

ANDORARADIO, which has the mailing address at P.O. Box 7, Andorra, is now officially in operation after its recent test broadcasts. The station has a 100 Kw. on 818 Kc. and on 6305 Kc. with 5 Kw. The station has programs in French and Spanish daily from 9.00 p.m. to 9.00 a.m. On Sunday the station opens its broadcasts at 6.00 p.m.

RADIO GLOBE, in Rio de Janeiro is on the air from 7.00 p.m. to 1.00 p.m. next day and is using the frequencies of 6035 and 11,805 Kc., both with 10 Kw., according to an attractive verification card. Another new Brazilian is at Sao Paulo and has been heard on 17,720 Kc. at 10.30 a.m. Its identification appears to be "Radio University." The Port Alegre station, on 6135 and 11,915 Kc want reports; it has been well received on the former frequency at 7.00 p.m. when opening transmission. Verification is in the form of an attractive pennant.

NORTH VIETNAM'S Home Service over Ra Hanoi is broadcast on 4730, 9940 and 15.022 a 9765 Kc. The station is on the air from 3 to 4.15 p.m., 7.30 to 1.15 a.m., and 8.30 a to 10.15 a.m. The foreign service of Ra Hanoi on 9840 and 11,840 Kc. is in French fr 10.30 to 11.30 p.m., and English from midnight 12.30 a.m. and 1.00 to 1.40 a.m.

FINLAND'S transmissions from Helsinki for summer months include English from 9.30 p. to midnight on 15.190 Kc., and 17.800 Kc. A other transmission from 10.00 p.m. to 11.00 p. is released on 9550 Kc.

VATICAN RADIO now has broadcasts in languages. English is now broadcast daily at 1 and 4.15 a.m. on 9646, 11,685, 15,120, and a at 8.30 p.m. on Monday, Wednesday and Fric on 17.735, 15,120, 21,515 Kc.

ANGOLA station, Radio Club de Cabinda, P. Box 116, Cabinda, is on the air 9.00 to 11. p.m. with 1 Kw., using 6R6RW on 5055 Kc. T station further broadcasts from 3.00 to 7.00 a. on the same frequency with only 250 watts. Ne in Portuguese is released at 10.00 p.m. and 5. a.m., each of 15 minutes duration.

COLOMBIAN station Radio Sutatenza plans increase its power, and is to use 50 Kw. on 50 Kc. and 10 Kw. on 6075 Kc. Station is broa casting at the moment from Bogota on HJC on 3250 Kc. 10 Kw., and HJGC on 5075 Kc. w 25 Kw. The broadcasts are from 8.50 p.m., midnight and from 4.00 a.m. to 1.05 p.m.

DACCA in Pakistan is to use a new 10 K short-wave relay station, which will be schedul to operate 10.30 a.m. to 2.00 p.m. on 15305 K 3.30 to 6.00 p.m. on 21 690 Kc., and 8.30 p. to 3.00 a.m. on 21,690 Kc.

BELGIAN CONGO relay stations are noted f the higher power they use in contrast with t many other stations in Africa. Latest inform tion from Radio Congo Belge is that Rad Leopoldville on 5965 Kc., 3 Kw., is on the a from 1.30 to 6.00 a.m. Radio Bukavu on 48 Kc., 10 Kw., 12.30 to 5.00 a.m. Radio Coqu hatville, on 6070 Kc. with 10 Kw., 1.30 to 6. a.m. Radio Elisabethville, on 5935 Kc. with Kw., 1.30 to 6.00 a.m. Radio Luluabourg, 6125 Kc., 10 Kw., 1.30 to 4.30 a.m. Rad Stanleyville, on 6079 Kc., 10 Kw., from 1.30 a. to 5.00 a.m.

WARSAW RADIO has English to Nor America from 10.30 to 11.30 p.m. on 15.275 K and this session is expected to provide fair r ception in our late evenings.

NEW SABC STATIONS. The reception of si nals from the South African Broadcasting Corpo ation at much improved strength is due to the ne transmitter and aerial arrays now being used the SABC national short-wave station near Bloer fontein. The station located on a 400-acre far 12 miles from the city is in the centre of t Union and the location known as Paradise or in Afrikaans "Paradys." Nine transmitters ea of 20.000 watts are installed and, of these, eig are in daily service, two for each of the fo programs being broadcast. The SABC has English, Afrikans, Commercial and African se vice in its schedule, while the other transmitter used for stand-by work and unscheduled broa casts. The aerial system includes 21 units, whi are beamed on various sections of the Unio while a further seven are for broadcasts beam at overseas countries.

The new installation is doing much to provi radio entertainment for isolated areas in Sou Africa. In this area in particular, its 60 and 9 metre signals show a big increase in sign strength, when one compares them with the o 5000-watt stations, which formerly carried the programs. The old transmitters were located Johannesburg, and other cities and their ma function was to relay the program on more less a regional basis. The new station is staff 24 hours of the day. At Paradys over half a mi lion pounds of wire has been laid in the grou for earths. Three medium-wave transmitters a also located at the station, these serving the ce tral Orange Free State region.

AMATEUR BANDS WITH BILL MOORE

During the warmer portion of the year practically every week-end is taken up with an Amateur Radio Convention or Field Day held in some part of Australia. These events provide amateurs with the opportunity to meet socially and are always well supported.

)T only was the weather unkind to partici-pants in the Six-hour Day weekend amateur ts in N.S.W. but radio propagation conditions at an all-time low. This latter fact ham-d contestants in some of the field events. ortunately, around the equinox anything is y to happen to our bands by way of iono-ric disturbances.

ie weather, however, did not prevent good ndances at both of the major N.S.W. events. Newcastle on the Saturday the Hunter ch's annual dinner was held.

anch president, Lionel Swain, VK2CS, occu-the chair. Guest speaker for the evening Allan Fairhall, M.H.R., VK2KB, who dis-d aspects of the work leading up to W.I.A. esentation at I.T.U., Geneva. He offered, too, pithy comment on W.I.A. activity and eur radio.

STINGUISHED VISITORS

e toast to amateur radio and the W.I.A. was ie capable hands of Ray Carter, VK2HC, and president, Dave Duff, VK2EO, replied on lf of the amateur service and the institute. any distinguished visitors were amongst the persons seated at dinner and Mr Griffiths, .R., spoke on their behalf in reply to a wel-e extended by branch vice-president, Bob , VK2AQR.

epresenting the Newcastle section of the I.R.E. chairman Mr W. Kirchner, VK2ZK, and the G.'s Department Mr Frank Hinks. Wal Han-VK2AXH, spoke on behalf of the old-rs present. Publicity was afforded the dinner oth the Newcastle and Sydney Press.

ie Blackalls Field Day held on the Sunday was attended, despite the rain.

inners of the field events were 144 Mcs. morn-nunt: 1st, Bob Lear, VK2ASZ; 2nd, Jim Cum-s, VK2PM. Seven Mcs. scramble: 1st, Jim mings, VK2PM; 2nd, Ken Mitchelhill, ANU. 144 Mcs. afternoon hunt: 1st, Jim mings, VK2PM; 2nd, Ken Mitchelhill, ANU.

embers of the branch and visitors, too, spoke y of the organising work of secretary Gordon erland.

the same weekend, down in the south-west-zone conducted their annual convention with persons attending. The Narrandera Radio were the organisers and held the convention hat town. During the Saturday afternoon, rs were entertained by the Moonah Festival ession.

e dinner in the evening was under the chair-hip of zone officer Jim Edge, VK2AJO, and kers included the Mayor, club president Bill VK2AHV, and guest Ted Whiting, VK2ACD. A. divisional councillor and publicity officer. sitors attended from as far south as Mel-ie and north to Sydney.

AIN FIELD EVENT

e winner of the main field event, the all-scramble, was Ross Weeden, VK2PN, of lf.

attending appreciated the arrangements made iembers of the Narrandera Radio Club for wellbeing. Special mention should be made ie work of the president's wife, Mrs Mill; was a tower of strength.

e Gosford Radio Club, the central coast sec-of the W.I.A., will hold their annual field n Sunday, November 22, at the same venue st year, the Gosford Sailing Club's rooms, the Olympic Pool just out of the Gosford ing centre.

nilar events have been held annually in the tl coast area for over 25 years and are al-popular. This year's event should prove no tion.

location is in ideal surroundings and the events are always interesting amongst the of bays and inlets. The field day will be cted on similar lines to last year.

mbers of the Gosford Club are organising the rogram and over 200 persons have attended ist two field days held at that location. is one of the most popular of the N.S.W ur events and well worth the trip to Gos-for the day.

npetition is always keen in the field events your gear needs to be "hotted up" if you to be amongst the winners.

★ ★ ★

ATEURS, short-wave listeners and intending amateurs desirous of joining the Wireless In-of Australia should contact the secretary division in the State in which they reside. .A. members enjoy many privileges and services, including appropriate technical lectures, QSL service, disposals, their journal, "Amateur Radio," etc. The Institute, too, needs the support of all persons interested in the amateur service so it can most effectively represent the amateur and the enthusiast at all levels.

The most important job on hand is, of course, representation at the I.T.U. conference now in session at Geneva.

The W.I.A. has divisions in all States of the Commonwealth and inquiries re membership should be directed to the addresses listed below:

N.S.W.: Box 1734, G.P.O., Sydney.
Vic.: P.O. Box 36, East Melbourne, C2.
Queensland: Box 638J, G.P.O., Brisbane.
South Australia: Box 1234, G.P.O., Adelaide.
Western Australia: Box N1002, G.P.O., Perth.
Tasmania: Box 371B, G.P.O., Hobart.
Papua-New Guinea: P.O. Box 204, Port Moresby.

144 Mc. XMITTER HUNTS

THE N.S.W. V.H.F. and TV group through the years has conducted many successful night and daylight 144 Mc. hidden transmitter hunts. They have always been very popular, and to hold the support for such searches the rules have been varied from time to time.

Rules for the current series are quite interesting and may provide other groups with ideas for search events.

The arrangements for nocturnal hidden transmitter (fox) hunts are as follows:

The hounds will assemble at a previously arranged point.

The starting point will be chosen by the amateur who is hiding the transmitter.

The hidden transmitter must be so placed that its antenna be visible and accessible from the hounds' car.

Prior to 8 p.m., the normal starting time, all the participating hounds' cars speedometer readings will be noted.

Just before 8 p.m. the fox will contact one of the hounds' cars at the starting point and the latter will inform the fox of the number of cars participating. The fox will then declare the hunt open and modulate his transmitter with tone until 9.30 p.m.

He will at the completion of transmission of tone announce his hiding place and attempt to contact as many of the hounds still in the field as possible and direct them to his location.

The first hound to find the fox before 9.30 p.m. will receive three points, the second two points and the third one point.

The hound travelling the closest to the mileage between start and finish and arriving before 9.30 p.m. will receive one point to be added to his previous score.

The fox will calculate the lowest possible mileage between the starting point and the hidden location and allowing for a constant speed of 30 m.p.h. will assess the minimum time in which the hounds can arrive at the hidden location. Should hounds arrive under the minimum time they will become ineligible for scores.

Daylight transmitter hunts: The same rules will apply for day events with the following exceptions:

The starting time will be in the morning, usually 10 a.m.

The duration of the hunt will be as arranged. As these hunts are conducted over greater distances, than for evening events, the minimum time proviso is calculated on a 40 m.p.h. basis.

N.S.W. DIVISION W.I.A.

BOB RIDGLEY, VK2ZAN, lectured at the September meeting of the N.S.W. division and his subject covered the many phases of V.H.F. equipment and operation. Items of the Federal convention minutes were discussed at length.

Two overseas visitors were present, DL2SJ and OH2MT. The latter will be a resident of Sydney for some time as he is attached to the Finnish Legation in that city. In recent years he has been staying in W-Land and is anxious to see the VK's in operation.

Both visitors were presented with copies of the W.I.A.'s call-book to ensure they will be able to locate the locals.

The nightly Morse practice transmission of the N.S.W. division commenced in September and appears on 3535 Kcs. from 7.30 to 8.00 p.m. A roster has been arranged and many amateurs in the city and country are assisting in the program using the call of the division, VK2AWI. Amateurs at the moment participating are VK2OA, VK2OT, VK2XP, VK2JR, VK2WH, VK2ASF, VK2GJ, VK2ACO, VK2EU, VK2AEE, VK2AQU, VK2ANU, VK2EN, VK2ACP.

The N.S.W. V.H.F. and TV section also conducts Morse practices on 144 Mcs. They are run between 7 p.m. and 8 p.m. on Tuesday and Thursday evenings.

★ ★ ★

Fijian amateurs made quite an impression in mid-September, when the Fiji Radio Club set up VR2FRC during their Hibiscus Festival. Unfortunately, equipment was only available for the 21 Mcs. band on the final check, but operators made dozens of contacts. News of the festival was broadcast to many parts of the world on 21 Mcs.

DURAL SITE

A DEAL of work is still being carried out on the grounds at VK2WI, Dural. Clearing of the grounds is well under way under the guidance of Laurie Cartwright, VK2ZJC.

The subject of the provision of tables for picnics has been discussed, as has the value of the grounds as a stay-over location for caravans of country members on visit to Sydney.

The N.S.W. W.I.A. S.W.L. section's membership now stands at 141. The section will discuss awards for S.W.L.s at a future meeting. Official numbers are available to S.W.L.s in all States of Australia to associate members of the W.I.A.

In N.S.W., secretary Jim Mills, VK2ZTM, would be pleased to hear from S.W.L.s desirous of joining the section and the W.I.A.

In recent years various clubs and divisions of the W.I.A. have set up amateur stations at festivals and other public functions.

This work has provided much valuable publicity for the amateur radio service. Such demonstrations too attract newcomers to the ranks. With this work and emergency working, amateur radio

(Continued on page 115)

THE AMATEUR OPERATOR'S PLEDGE

AN interesting insight into the ideals and procedures of amateur radio is provided in a "Ham's Pledge" composed by Ray Bryan, W5UYQ. It is a well-worded document and worth keeping in a prominent place in the shack and applicable to amateurs throughout the world. It is really a repetition of the amateur code, plus the features of good operating procedure.

The preamble runs as follows and is headed by the callsign:

"I am proud of this call because I am the only person in the world who has the privilege of using it.

"It identifies me more than my own name as thousands of unseen friends will know me only by my call.

"What I do when on the air with this cherished call will bring untold friends or enemies for life. It all depends on me, as I will not be judged by looks or station in life, but by my manners and the consideration I show my fellow Hams while on the air.

"I value my friends more than my possessions.

"To make this friendship stronger I pledge myself to be a better operator by following these good operating practices:

"1. I will listen on the frequency before testing or transmitting.

"2. I will give the frequency immediately to a station calling break or emergency, I will assume that his call is urgent.

"3. I will acknowledge a joining station immediately as he may have an important message.

"4. When wishing to join a QSO, I will announce my call only between transmission breaks.

"5. When working mobile or on known mobile frequencies I will keep contacts short and allow time between transmissions for new callers or urgent traffic.

"6. I will not forget mobiles are in motion and must have priority with short contacts. They are handicapped with low power and limited frequencies.

"7. I will always be helpful and tolerant with my fellow amateur.

"8. I will gladly take or give advice when I know it will help my fellow amateur or the hobby.

"9. I will serve the public whenever the opportunity arrives.

"10. I will do all in my power to cause my fellowman to respect all radio amateurs."

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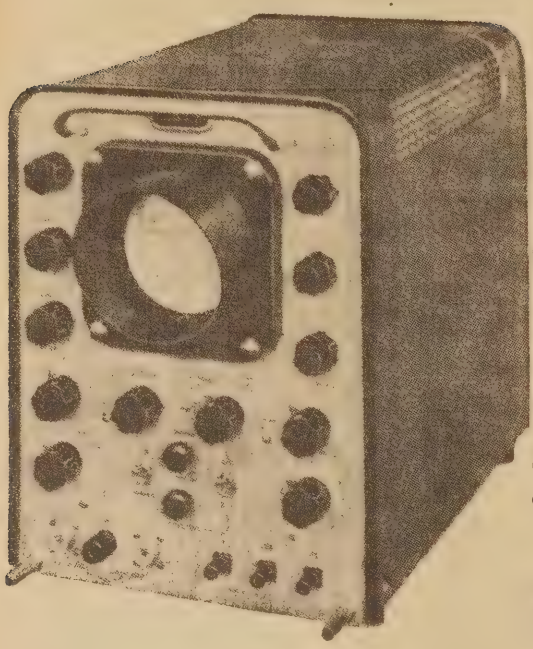

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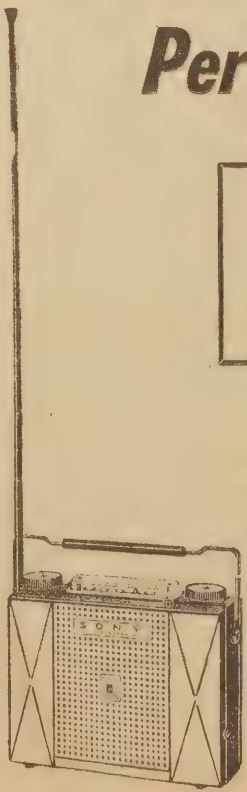

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far better known to the general public than it a few years ago.
The latest venture, on a very suitable occasion, during Apprenticeship Week, held in Sep-ber in N.S.W.
Using the N.S.W division's callsign, VK2AWI, tation was operated from the Grafton Techni-College during the week. The college was n to the public for inspection and the trans-ter provided the demonstration and a very ent signal on the 7 Mcs. band. It was an resting display for many observers and Bill twright, VK2OE, was responsible for most of work on the project

I.T.U. CONFERENCE

OST amateurs are anxiously awaiting the out-come of the deliberations of the I.T.U. con-nce at Geneva. At the time of writing the e news available indicates that decisions have n reached on sections of the radio spectrum. the earlier stages of the meeting, information ilable is confidential and any news and re-ts provided by the W.I.A.'s delegate, John yle, VK2JU, will in due course be promul-d by the W.I.A.'s Federal executive.

NOTES FROM BRITAIN

N increase of nearly 500 applicants was re-corded for the mid-1959 amateur examination ducted by the city and guilds of London over 1958 figures The all-time high figure of 0 entrants was reached for this year's exam-ion.

he R.S.G.B. reports that certain amateurs can claim taxation rebates for society member-dues. The terms are rather complex but are rally applicable to members whose perform-e of the duties of office or employment is ctly affected by knowledge gained through ety membership.
is an extension of the taxation privileges rded members of professional institutes.

EXTRA CLASS LICENCE

HE F.C.C. has given notice of an inquiry into the status of the extra class amateur radio nce. This class of licence is the highest avail-in the U.S., with a 20 w.p.m. Morse re-ement and a stiffer technical examination than other classes.

petition submitted to the F.C.C. suggests that the present extra class be divided into groups: Extra radio-telegraph licensees and radiotelephone licensees.

condly, award a "Radio Pioneer Certificate" mateurs licensed prior to April 6, 1917, in of issuing them extra class licences, but with he privileges of the present extra class

irdly, change the permissible maximum power t of amateur stations by, generally speaking, cing the limit for all classes of licensees of eur stations except those holders of extra licences (either radio-telegraph or radio-tele-e) or radio pioneer certificates who would be itted a maximum power input of 1000 watts e F.C.C. appreciates the object of the peti-to restore a degree of privilege to the extra licences, while it finds the proposals not ble nor in the public interest.

e F.C.C., however, proposes to call for any stions that could restore meaning and privi-to the extra class licence.

erested parties will be able to file comments tining alternative proposals that might accom-the purpose of the petitioner and the F.C.C.

y interested party may file a written state-or brief setting out his views.

interesting point, an original and fourteen s of all statements, briefs, etc., shall be fur-d to the commission. We worry about forms plicate!

21-28 Mc. CONTEST

E R.S.G.B.'s annual 21 and 28 Mcs. tele-hony contest will this year be run on No-er 21 and 22. It is open to radio amateurs ghout the world (not restricted as is the .U. contest).

usual serial numbers must be exchanged—.S. plus three figures starting from 001 for rst contact.

y one contact may be made with each sta-on each band. Cross band contacts are not tted.

y one entrant will be permitted to operate ation for the duration of the contest.

s should be forwarded to the contest com-, Radio Society of Great Britain, New Rus-louse, Little Russell Street, London, W.C.1. cates will be awarded to the leading station ch overseas country, VE, VK, W/K, ZL S call areas count separately for award pur-

vard, W2QHH, the doyen of amateur award ors, has added yet another one to his well-d shack wall. He recently qualified for /1000. He is the first OM to confirm ts with 1000 Y.L's. a novel distinction. d is described as one of the most certi-hams, if not the most certificated, in the in W3VKD'S "Ham Register."
certificate business is growing daily, G's "Directory of Certificates" and awards over 200 such certificates and there are more to come.

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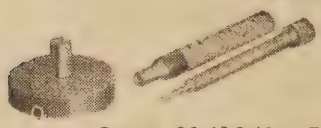

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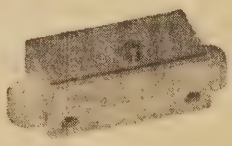
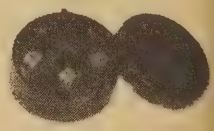


TYPE C



TYPE SF

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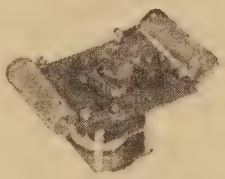

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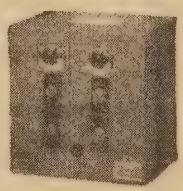

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LET'S BUY AN ARGUMENT

(Continued from Page 99)

tors. However, because it isn't so urgent, the process has been a slower one. Thus designers, manufacturers — and magazines — who would not normally think of anything but a .47M resistor, occasionally specify a 0.5mfd. capacitor, without noting the inconsistency.

But, of course, our correspondent's present problem is to know what to do with the many "round figure" components which at present grace his junk box. Perhaps the problem isn't as bad as he thinks.

If my experience of old tubular capacitors is any criterion, two-thirds of those which he's worried about ought to be thrown out anyway, or reserved for nothing more than cathode bypasses. In such a role, provided they're big enough, they'll do.

Old resistors? They may be electrically O.K. and it should be possible to use up a good many of them in unritical positions in place of nearby preferred values.

Or, a check on an ohmmeter may show that their value true is within 10 p.c. of the specified figure, in which case no electrical compromise is involved.

I'm afraid my reaction is to regard my own junk resistors as a rather scrubby lot for many applications and I simply buy new ones!

ABOUT STEREO

By way of a change from resistors, I quote two letters which came to hand, following the publication of an article on stereo, in the August issue, by D. C. Hoefler. These letters would more logically have followed last month but they were crowded out by the rather lengthy dissertation on electric shock.

In general, I can only say that I agree with the objections raised by the correspondents. Mr Hoefler certainly does appear to contradict himself or to cut the ground from under his own feet (if you prefer the somewhat more colourful method of expression.

Mr Hoefler's objections to compromise stereo may be valid and for other reasons. I imagine that both correspondents admit as much. The point is that such reasons do not emerge from the article and may require, for their demonstration, a much more fundamental approach.

As far as the reference to speaker matching is concerned, I can't help but agree that Mr Hoefler appears to have fallen completely into a very old trap and perhaps a very new one, as well.

The old one is simply this: A speaker does not normally operate from a source of equal or matched impedance. The source impedance provided by an amplifier is normally and intentionally very much lower than the voice coil impedance, and, in fact, there are plenty of folk who will argue that the source impedance should actually be a negative quantity.

The question of matching is completely the other way round. The speaker provides the load into which the amplifier delivers its power. The requirement is to get the speaker match the load requirements of the amplifier.

The newer trap involves the whole question of phase between the two output signals.

If the third speaker is connected between two points which are symmetrically placed and in phase, then it will receive NO POWER therefrom and impose no loading on the source amplifiers.

But if, at other frequencies, the instantaneous signals are out-of-phase, then the third speaker may get more than its intended share of the output and impose greater loading as a result.

In other words, the power reaching the third speaker might simply be an "accident" of phase between the channels at various frequencies and instants.

IMPEDANCE MATCH?

And it also raises the question: Is it possible to speak of impedance matching between two circuits which are fundamentally carrying different signals?

It is no longer a question of a certain signal voltage relating to certain signal current. You have two "unrelated" voltage points and the current between them must be a mutual resultant.

What resistance or impedance can you possibly make out of this, relative to either channel.

And this has to be decided before you can even begin to talk about tappings on the secondary windings.

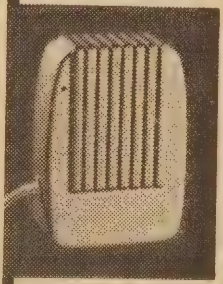
In short, I can't help but agree that our American writer friend does appear to have bought himself an argument—or perhaps several arguments.

In the meantime, by the look of the letters coming to hand, I'm going to have an easy month, as far as "Argument" is concerned. By the time I string three or four of them together, there won't be much room for lengthy additional writing.

But why worry? If the material makes for good reading and good thinking, that's what really counts.

AWA RONETTE

MICROPHONES & ACCESSORIES



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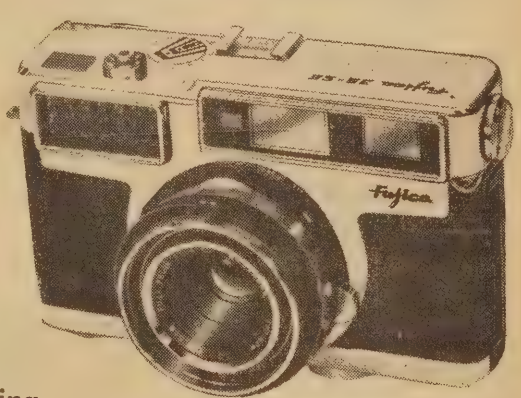

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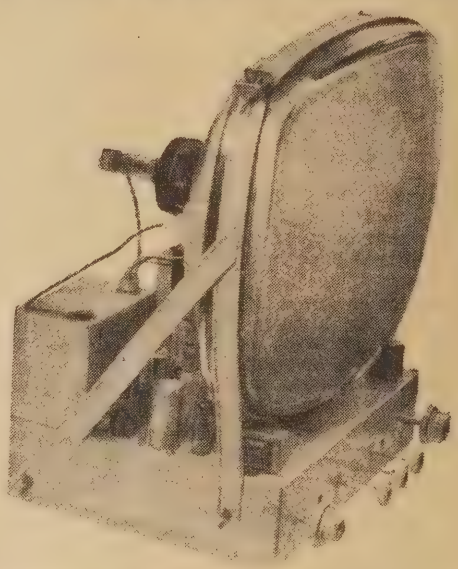

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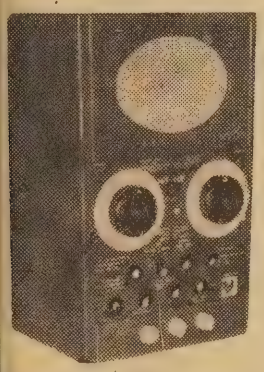

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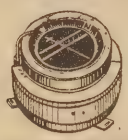

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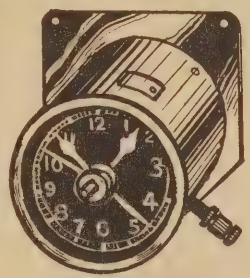

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Ex-Rolls-Royce Merlin, **ELGIN**
with sweep second indicator.
£6/10/-
Post: N.S.W., 4/6; Int., 5/-.

VALVES, NEW

1R5	12/6	6AG5	7/6
IT4	10/	9006	15/
3A4	12/6	837	9/6
6C4	7/6	83	9/6
6J6	15/		

B.T.118 transmitter valve £3/10/ ea.
Add postage.

DRIFT SIGHT
Canada Mk. II contains these lenses: 2 acromatic 1¼in diam., 5in focal length, 1 Bi-convex 2in diam., 9in focal length, 1 plane convex, 2in diam., and 9in focal length, 1 small elliptical mirror, minor axis 1 7/16in, 1 flat optical front silvered mirror, 1¾4in x 2 7/8in, 1 4in ground glass disc and sundry parts, etc. 42/6 ea.
Post: N.S.W., 7/; Int., 9/6.

HEADPHONES
High Impedance. Suit Crystal Sets. Lightweight. American.
22/6 pair
Post: N.S.W., 2/6; Int., 3/-.

AIR SPEED INDICATORS
NEW.
8/6
Post: N.S.W., 2/6; Int., 3/-.

BOOSTER COILS
For racing enthusiasts.
12 or 24v, Bendix, new type 512. Platinum Points.
22/6 each
Post: N.S.W., 2/6; Int., 3/-.

MANIFOLD PRESSURE or VACUUM GAUGE
£1 each
NEW.
Post: N.S.W., 2/6; Int., 3/-.

OSTER MOTOR
1/25 H.P. continuous duty 5600 r.p.m. Ideal for use on 32v lighting plant, £4/15/.
Post: 9/6; Int., 12/-.

FIELD STRENGTH METER
OUTFIT 1E/18/A
BRAND NEW.
COMPLETE.
100 to 155 Mcs.
With 0-1 internal/external shunt meter, tools, battery box, signal generator and instruction book in dovetailed wooden case.
£17/10/-
Freight payable at nearest attended railway station.

522 TRANSCEIVER
Complete £12/10/; 522 Transmitter £6/15/; 522 Receiver, £6/15/; 522 Chassis.
45/-

RANGE FINDERS
Horizon and Bubble Type.
Mark IIIB.
Complete with Leather Case.
Dimensions, 9in x 4in x 2in.
Ex-R.A.A.F.
ORIGINAL COST. £30.

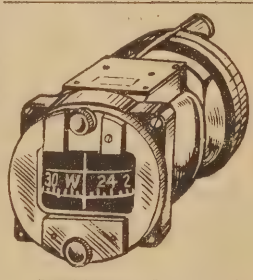
PRICE 35/-
Post: N.S.W., 5/-; Int., 7/6.

TRANSFORMER AND RECTIFIER UNIT
Ideal for relay operating. Input 10v, 240v A.C., Output 241, 57v. DC
35/-
Post: N.S.W., 5/; Int., 7/6.

No. 19 TRANSCEIVER
(Two-way Radio). With power pack, junction box, leads, etc.
£15 each.

WHIP AERIALS
Ideal for car or TV antenna or blackfish rods. 13ft in 12in sections.
19/6
Post: 2/6; Int., 3/-.

GEARED MOTOR
Genuine Oster variable 12/24 type. B/9/1, .7 amp. Motor r.p.m. 5600, but geared down r.p.m. output is variable, 6 to 20, 57/6 ea.
Post: N.S.W., 7/-; Int., 9/6.



Dashboard COMPASS
Small ships. Pioneer American. Liquid Damped with Light. Also suit as car compass.
£7/15/-

COMMAND RACKS
Receiver 3 tier, 19/6 ea.
Transmitter, 1 tier, 12/6.
2 tier, 15/ each.
Post: 3/; Int., 4/-.

CHASSIS
RT24/APX2 15 miniature seven-pin ceramic valve sockets and covers, trannies, etc.
45/- ea.

CONDENSER LENSES, 3½in WITH CELL.
£3/15/-
Reflector Mirror. Lens. Lamp-holder, 35/ extra.
Post: N.S.W., 7/-; Interstate, 9/

LENSES AND PRISMS
11in Diam. Piano Convex Conder
ser Lens, £7/15/ ea. or £14 p
Objective Lens 20in F.L. 2 5/16i
diam 95/ e
Objective Lens, 16in F.L. 2in diam
50/ e
Lens Cell and Filter, 2 5/16in diam
25/ e
Eyepiece, low power, 1¼in F.L.,
£3 e
Eyepiece, high power, 5/8in F.L.,
£4/10/ e
Right-angle Prism, 2¼in square fac
£3 e
Small Erecting Prism £1 e
Large Erecting Prism 25 /e
Add Postage.

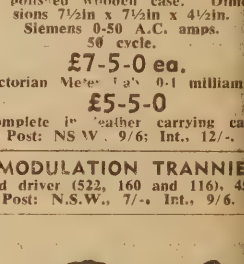
GEARED ROTATING BASE
6¾in diam, full azimuth circle wi
Surveyor's Compass.
£4/15/ ea.
Post: N.S.W., 9/6; Int., 12/-.

PERISCOPES
10in x 4in x 1¼in. Contain tw
front silvered mirrors 3½in x 1¼i
x 1/8in.
12/6 ea.
Post: N.S.W. 3/-; Int. 4/-

HYDROGEN BALLOONS
5ft diam, NEW, complete with Generator.
42/6
Post: N.S.W., 5/-; Interstate, 6/-.

METERS
In polished wooden case. Dime
sions 7½in x 7½in x 4½in.
Siemens 0-50 A.C. amps.
50 cycle.
£7-5-0 ea.
Victorian Mete[illegible] 0-1 milliamp
£5-5-0
Complete in leather carrying cas
Post: NS W. 9/6; Int., 12/-.

MODULATION TRANNIE
and driver (522, 160 and 116), 45
Post: N.S.W., 7/-. Int., 9/6.



GUNSIGHTS
Contain these lenses:
1 lens 1in Focus, ½in diam.
1 Lens 1 11/16in Focus, 1¼in di
1 Air Spaced Lens, 1¼in diam
1 Filter Lens, 1 Graticule.
1 Lampholder.
18/6 each
Post: N.S.W., 2/6; Int., 3/-.

TELEPHONE CABLE
BRAND NEW. NYLEX ROTPROOF COVERED.
£4/17/6 per mile
Freight payable at nearest attende
railway station.

DEITCH BROS.
70 OXFORD STREET, SYDNEY
Between Crown and Riley Street, City.

NEW JOBS FOR INFRA-RED RAYS

(Continued from Page 19)

Blood stains, pieces of paint from motor car bodies and fabric from clothing, all have their particular characteristics under infra-red radiation and are subject to analysis and identification.

By rotating the prism different wavelengths of infra-red are brought on to the slit.

If an absorbing substance is inserted between the light filament and the slit, the radiation of infra-red passing through the slit is weakened at the wavelength which is absorbed. Thus, by comparing with known standards, the substance can be studied and analysed. A diagram is displayed here which shows the setup of an infra-red spectrometer. In the diagram, rays from slit S are directed by mirror M1 through the rock salt prism A, then via mirror M2 on to the thermogalvanometer P.

MEASURING TEMPERATURE

Because of the penetration effects of infra-red, temperature distribution throughout the human body can be measured by suitable devices.

Special infra-red lamp radiators of great efficiency are now being manufactured which have very great value in industrial applications and on farms and in hospitals.

In appearance these lamps are similar to an ordinary spot light with an internal reflector. The filament however is of special construction and they are run at an extremely high temperature, somewhere in the vicinity of 3,000 degrees centigrade.

Banks of infra-red lamps have valuable applications in industry. They are used in the tobacco industry for preparying the stems of tobacco leaves.

In the textile industry, where manufactured material must be dried, infra-red lamps have replaced the old hot-air oven. The material passes over an aluminium reflector plate. Above this plain is a bank of probably 125 lamps. The reflector plate reflects back into the fabric any rays which get through from the bank of lamps above. It takes only about 15 seconds to dry out the material. Because of this an increase of production of 75 per cent has been gained with woollen fabrics and 40 per cent with artificial fibre material.

SHOES, LEATHER SOLES

Infra-red drying of cork fillings for shoes, wet leather soles and lacquer has reduced the drying time from hours minutes to five minutes.

Large banks of lamps are used in the printing industry to dry varnished paper and the gum on envelopes.

One great advantage of infra-red lamps is the portability of the installation. Banks of lamps can be mounted on wheels and wheeled to any desired location. This is particularly valuable in the painting of motor car bodies. The rays can be directed on any particular part of a car which has been painted. In large plants very large installations of infra-red lamps have been arranged in the three walls and roof of a special room. Waggons which have been painted all over move gradually through the room.

Drying time has been reduced from days to three days to 25 to 30 minutes.

In chemical laboratories infra-red lamps are replacing the old naked burner for boiling liquids in glass vessels. A lamp placed beneath the vessel boils the contents very quickly with the added advantage that, should it boil dry, no damage will take place to the vessel because glass is a bad absorber of infra-red rays and thus there is little concentration of heat on the bottom of the glass.

In the wool industry a process called carbonisation is necessary in order to remove impurities from the cloth. After treatment with acid the cloth is dried and then rapidly brought to and maintained for a short time at a temperature of about 150 degrees Centigrade.

This treatment causes impurities to carbonise and they are then removed from the cloth in a special beating machine.

By the use of infra-red lamps the drying time has been reduced, resulting in an increase of anything from 400 to 700 per cent in the rate at which the material can be run through the drying room.

In the agricultural industries and on the poultry and pig farms infra-red lamps are becoming popular, as, for example, in chicken brooders.

RISK OF SUFFOCATION

Formerly the chickens had to be kept in hooded brooders which were subject to fumes from lamps or lack of proper ventilation. This led to the chickens being suffocated.

With the use of infra-red lamps no hood is necessary. The chicks move freely about their enclosure.

One of the things which pig farmers have to watch for is the overlaying of piglets by the mother. They snuggle underneath for warmth but there is always the risk that the big awkward mother will turn over and crush her family.

By taking the piglets from the mother and keeping them in an enclosure over which is suspended one or two infra-red lamps, the mortality among young pigs is kept at a minimum or entirely overcome.

When lamps are suspended over the same pen which holds both the mother and the piglets the latter will often prefer the warmth from the lamps to that of the mother and will go to the mother only for feeding. One 250 watt lamp is usually sufficient for 5 piglets.

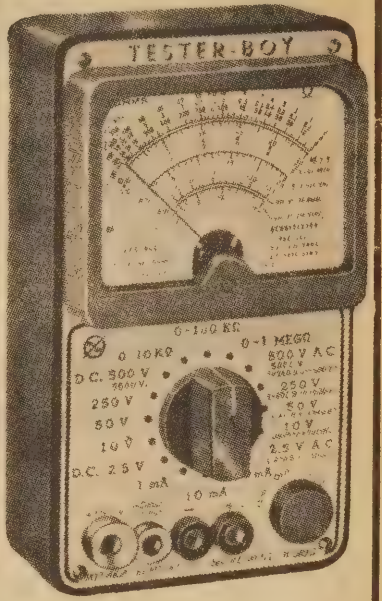
In the medical application of infra-red rays the important thing is the wavelength of the rays administered. Some rays penetrate deeper into the tissues than others.

It will thus be seen that simply hanging an arm or joint under a lamp is only a hit-or-miss method. To be of the utmost value proper infra-red equipment should be used so that the wavelength can be controlled according to the kind of complaint.

There is a lamp on the market however which has been scientifically designed to generate rays at about the average wavelength necessary for quite a number of maladies. For more serious and deep-seated or prolonged muscular or bone complaints it is advisable to have medical advice.

"TESTER BOY"

Complete with Leather case
Test Leads and Batteries



Specifications:
Clear scale 3in x 2in.
Overall dimensions in carrying case, 4½in x 6in x 2½in.
1,000 O.P.V. highly damped movement.
Volts: AC and DC.
6 ranges to 5,000V.
Resistance: 3 ranges to 1 megohm.
Current: 3 ranges to 500 mA.
Output: 2 ranges minus 20 to plus 56 db.

Price £7/10/-

Post—N.S.W., 2/3; Qld., Vic., Tas., 3/8; S.A., W.A., N.T., 5/.

IMPORTED RADIOS

Miniature Diode Crystal Sets with earphone.
Sputnik Model, 3½in high £1/19/6
707 Jet Plane Model, 9in wing span, £1/19/6
Rocket JRI Model, 5in high ... £1/19/6
Miniature Case Models.
Fuji 56E, 2½in x 3¼in x ¾in. £2/19/6
Shield RA277, 3½in x 2½in x 1in. £3/15/
Crown GRIO, 2½in x 1¼in x 1¼in. £4/15/
1 Transistor and Diode with Earphone.
"Crown" Model TRI, 3½in x 2in x 1in. £5/9/6
"Faraday" Model TRIA, 3¼in x 2in x 1in. £4/18/
2 Transistor with Earphone.
"Beacon" Dual Wave, 2 bands, 4½in x 2¾in x 1¼in £10/10/
Transistor with Speaker and Earphone.
3 Transistor "Crown" portable Radio, 4in x 2½in x ¼in. £14/19/6
4 Transistor "Aiwa" portable Radio, 5in x 3in x 1¼in £19/17/6
6 Transistor "Sydney" portable Radio, 6in x 4in x 1¾in. £22/10/
6 Transistor "Sanyo" portable Radio, 5in x 3in x 1½in £24/15/
7 Transistor "Toshiba" Dual wave portable, 7in x 4in x 2in £33
8 Transistor "Sanyo" Dual wave portable, 6½in x 3½in x 2in. £44/2/
Portable Dual wave Models with Telescopic Aerials.

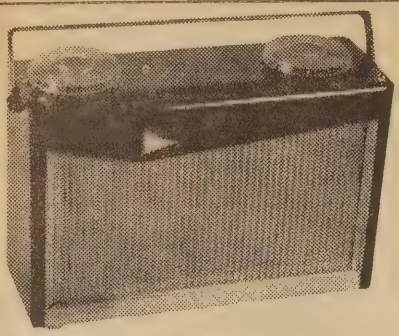
Write for your free copy of our Resistor Colour Code.

MAIL ORDERS

Radio House Pty. Ltd.

296 Pitt St., Sydney

Also available at: 6 Royal Arcade and 760 George Street, Sydney.



MAKING R. & H. TRANSISTOR PORTABLE?

COMPLETE KIT OF PARTS

£26/10/-

Post extra

SET WIRED AND TESTED £2 EXTRA

Including 6 S.T.C. Transistors, R.C.S. Coilkit with printed circuits, Rola Transformers and 5F Speaker and all parts necessary to complete this Set including attractive and durable two-tone cabinet with gold trim.

Weight 11lb.
Cabinet size 13in x 10in x 6in.

PORTABLE TRANSISTOR RADIOGRAM

Complete Transistor Six Kit with B.S.R. four-speed motor and crystal pick-up and attractive two-tone covered cabinet **£35**

As above, but with SEVEN TRANSISTOR KIT, **£37/10/-**
Above sets wired and tested, 6 Trans. 55/
7 Trans., 75/ extra.

PORTABLE TRANSISTOR-GRAM

Complete kit including B.S.R. Motor and Pick-up (4-speed) and attractive two-tone covered cabinet **£25**
Wired and Tested, £2 extra. Postage extra.

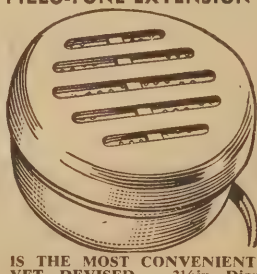
7 TRANSISTOR PORTABLE

Weight, 11b. Cabinet size 13in 10in x 6in. Specifications as above but with extra I.F. stage, giving better range and selectivity; also has extra coil for connecting to car aerial, making it ideal as a car set or for country locations. **£29** Post Extra.
WIRED AND TESTED, £3 EXTRA.

4 TRANSISTOR SET

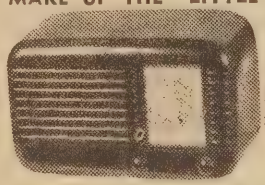
(As described in May "Radio and Hobbies")
Complete kit of parts less cabinet. Attractive two-tone covered cabinet, 47/6 extra.
£13/15/- Post Extra.

PILLO-FONE EXTENSION UNIT



IT'S A REAL MINIATURE WITH ROLA UNIT.
Install it anywhere, in the sick room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The 'PILLO-FONE' IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3½in Diameter by 1¾indeep. POST FREE. **22/6**

MAKE UP THE "LITTLE GENERAL"



£12/17/6

Complete kit of parts for the 1957 "Little General" as featured in R. and H., including attractive bakelite cabinet with slide dial. Price includes valves and Rola 5F Speaker and kit is complete to the last nut and bolt. (Set wired and tested, £2/15/ extra.
Cabinet size, 11½in long, 7in high, 6in deep.
Foundation Kit for above comprising Bakelite Cabinet, Chassis and Dial Assembly .. 57/6
Post and Packing: N.S.W., 14/6;
Interstate, 25/-.

CONDENSER SPECIALS

Boxes of 100 new ceramic, mica, paper and electrolytic condensers in values ranging from 50pf mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, 1. Also 500 mfd/12v., 10 mfd/40v., 16 mfd/350v., electrolytics.

25/- per 100.
Post Extra: N.S.W., 2/6; Int., 3/6.

CONDENSER SPECIALS

100 new mica paper and ceramic condensers, mixed values.

15/- Post 2/.

NEW I.R.C. RESISTORS

I.R.C carbon resistors, ½, 1 and 2 watt, in values 50 ohms to 5 meg., including many popular sizes. 3T, 15T, 20T, 50T, 100T, 250T, 500T, etc.
(Standard resistor colour code supplied.)

100 for 25/- Plus 1/6 postage.

NEW METER RECTIFIERS

Westinghouse 1 mA rectifiers, 15/

ELECTROLYTIC CONDENSERS

New Dubilier pigtail condensers.

8mfd 600V	3/9
16mfd 600V	5/9

Post Extra

TAPE-RECORDER MOTORS

New Collaro Tape Recorder Motors, 240 volt, A.C. Adaptable for many uses. **37/6** Post extra.

DYNAMIC SPEAKERS

New 7in Dynamic Speakers.
1500 ohm. Field, 25/.
5T or 7T trans., 10/- extra.
Plus postage.

NEW 4in. PER-MAG. SPEAKERS

5T or 7T Trans.

25/-

Post and Packing, 3/6.

SPECIAL

New High-Fidelity 4-speed Record Changers, Turnover Crystal Pick-up, Sapphire Needles.

£10/15/- F.O.R.

STANDARD INTERMEDIATE FREQUENCY TRANSFORMERS

455Kc, 1¼in square can. Slug tuned.
4/9 post extra.

NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping. Sec. 285 x 285 with 6.3v filament winding 60mA.
Plus postage, N.S.W., **25/-** 3/6; Int., 5/3.

NEW MIDGET POWER TRANS.

40mA prim., 250v. Sec. 225 x 225 with 6.3v Fil. Winding Upright or Flat Mounting. Size 2in x 2½in.

25/- 2/6 Postage, N.S.W.; Interstate, 4/6.

30mA 240v Prim. 150 x 150v. Sec. with 6.3v Fil Winding.

22/6 Postage: N.S.W., 2/6 Interstate, 3/6.

MICA CONDENSERS

Standard Mica Condensers, small current types .00003 to .005, including most wanted values.
Postage 1/6
10/- per 100.

CARBON RESISTORS

New carbon resistors, mixed values. Well-known make. 10/ per 100. Post free.

NEW POTENTIOMETERS

WITH SWITCH STANDARD SPINDLE	WITH SWITCH SHORT SPINDLE	LESS SWITCH STANDARD SPINDLE	LESS SWITCH SHORT SPINDLE
25,000 ohms			50,000 ohms.
100,000 ohms	100,000 ohms.	100,000 ohms.	100,000 ohms.
500,000 ohms	500,000 ohms.	500,000 ohms.	500,000 ohms.
1 meg. ohm			
4/6 ea. 42/ doz.	2/6 ea. 24/ doz.	3/6 ea. 33/- doz.	1/9 ea. 16/ doz.

500,000 ohm pots can be supplied tapped at 40,000 if required, post extra.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7398

SPECIAL PURCHASE!

New 5 Valve Dual-Wave Radiogram Chassis

THESE NEW DUAL WAVE RADIOGRAM CHASSIS MADE BY LEADING MANUFACTURER ARE EQUIPPED WITH LATEST MINIATURE VALVES AND SUPPLIED WITH 12in ROLA SPEAKER.

F.O.R. PACKING 10/- EXTRA

£17/15/-

NEW VALVES AT BARGAIN PRICES

6J6	12/	6K8G	9/6	1C7G	5/	6H6	2/6	6V6GT	12/6
ECH 35/VR99A, Direct replacement for 6J8G	10/	6SJ7GT	9/6	1K5G	2/6	6H6GT	2/6	VR65A	2/6
		12K8	10/	1M5G	5/	6K7GT	7/9	41	7/6
1C4	7/6	EK32	10/6	1K7G	5/	6U7G	6/6	7193	3/6
1T4	7/6	6SA7GT	9/6	1L5	9/6	6J7G	5/	954	2/6
1S5	10/	6SH7	5/6	6AC7	2/6	7C7	3/6	12A6	7/6
3S4	10/	1Q5G	5/	6C8G	7/6	78	7/6	EF50	2/6
1R5	12/6	1P5G	5/	6SS7	8/6	EL32	10/6	811	£1
1A7GT	9/6							12SH7	5/
1D8GT	9/6							6K7G	4/6
5A8G	10/6							1C6	7/6
								955	2/6

SPECIAL PRICES FOR QUANTITIES.
Please add postage on all valves.

NEW VALVE SOCKETS

Ceramic EF50 sockets, 2/6 ea. American moulded Loctal, 1/ ea. Octal 8-pin water, 6/6 doz. Amphanol 5-pin ceramic, 2/6 ea. Amphanol small 7-pin ceramic, 2/6 ea. All post extra.

NEW RECORD PLAYER

4-speed B.S.R. Player with Turnover Crystal Pick-up and Amplifier in attractive Two-tone Cabinet.

18/15/-
F.O.R.

NEW STOCKS—

A COMPREHENSIVE STOCK OF NEW COMPONENTS FOR THE HOME CONSTRUCTOR AND SERVICEMAN ALWAYS AVAILABLE

24 HOUR MAIL ORDER SERVICE

RADIO-DISPOSAL STOCKS

All radio and electrical disposal goods previously sold at this address are now available only at:—

METROPOLITAN RADIO SUPPLIES

640 KING ST., ST. PETERS, N.S.W. PHONE: 51-8087

Radio Valves still available at the Stanmore address below

NATIONAL RADIO SUPPLIES

32 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7398

Homecrafts PTY LTD

Radio, Television and Hobbie SPECIALISTS

290 LONSDALE STREET, MELBOURNE – FB 3711

HOMECRAFTS NEW MOTOR SCOOTER DEPT.

5 Sensational Models of the world's most popular Motor Scooter.

VESPA 125cc De Luxe .... 199 Gns.
125cc Special ..... 234 Gns.
150cc De Luxe .. 232 Gns.
150cc Special ..... 262 Gns.
150cc Gran Sports 270 Gns.

Trade-ins accepted as part or full deposit.

Easy Terms from 52/6 weekly
ALL Vespa Spares and Accessories.

WHY WASTE YOUR HOBBY TIME IN LAWN MOWING?
Buy Australia's most popular Motor Mower.

VICTA Models from **49 Gns.**
or 7/6 weekly

Limit No. QUALCAST
BIG CUT MOTOR MOWERS.
Normal Price, 45 Gns.
RADIO AND HOBBIES Readers from this month,
29 Gns.
These Mowers are brand-new.

OUTBOARD MOTOR
SPECIAL ! 2H.P. £59/10/0
Easy Terms available. 3H.P. £69/10/0

BOATS, The Famous UMI WATERSPITE 8ft. Aluminium, 79 gns. Easy terms available.

VISIT OUR NEW ENLARGED
BASEMENT SHOWROOM
ELECT., RADIO, TV AND HOBBIES BARGAINS
for Australia's Largest Range.

BARGAINS IN RADIO PARTS
£5,000 Surplus Radio Stocks Sacrifice.
Call and inspect our Bargain Table.

BRAND NEW—Limited Number only.
THORENS AUTOMATIC PLAYERS
in original cartons, Model CB83N, 19 Gns.
We pay freight within Victoria.

Call and See the NEW
NECCHI AUTOMATIC SEWING MACHINE
Easy terms available.
Trade-ins accepted as part or full deposit.

MAIL ORDERS PROMPTLY HANDLED
C.O.D. if you wish.

ROLA LOUDSPEAKERS

	£ s. d.		£ s. d.
2C	1 18 6	69L	3 9 6
3C	1 12 0	8H	2 10 0
4C	1 11 6	8K	2 12 6
4F	2 1 0	8M	3 3 0
4-5C	1 17 6	8MPA	3 3 0
4-5F	2 8 0	8MX	4 10 0
5C	1 13 6	10-3G	2 15 0
5CX	1 18 0	12K	3 6 0
5F	2 2 6	12M	4 1 0
5FX	2 5 6	12MX	6 16 6
57-H	2 8 0	12.0	6 0 0
57-L	3 3 6	12.0 De Luxe	6 10 6
6H	2 5 0	12-0X	11 4 0
6M	2 18 6	12UX	28 19 6
69H	2 15 0		

METAL CABINETS
Set of 16 Drawers, **48/6**

SUPER SPECIAL
9 VALVE HI-FI AMPLIFIER AND TUNER CHASSIS
Well-known Brand
To Clear £2

BRAND NEW!
THORENS CB43N AUTO CHANGERS £3

Imported Twin 3-watt
STEREO AMPLIFIER 25 gns

Special 5-watt Amplifier
HI-FI BASS and TREBLE CONTROL
£17/19/6

Brand New High Qualit
EXTENSION SPEAKERS
Attractive coloured leatherette cabinets £3/10/
Plus 25% tax.

SPECIAL!
CAD. PLATED STANDARD TV CHASSIS 5/
plus tax.

TO CLEAR
SECOND HAND RADIOGRAMS from £
EAC

STEREO RECORD PLAYING EQUIPMENT

We have everything for the Hi-Fi enthusiast

Grampian 590/2 Stereo Twin 8W. Amp	£91	0	0
Astronic Stereo Control	£48	1	0
Leak Stereo Point one Fre-amplifier	£60	0	0
Leak Stereo 20 Amp.	£87	0	0
Decca Stereo Pick-up	£42	0	0
Orpheus Std. Turntable	£29	17	6
Orpheus New Silex Turntable	£37	17	0
World Famous Dust Bag Record Cleaner	£2	13	11
BJ alignment Protractor for Pick-ups	£1	1	0

Wharfedale Speakers ex. Stock.

Super 3	£13	12	
Super 8FS	£13	0	
Super 8FSAL	£13	12	
Bronze 8FSAL	£7	6	
Bronze 10FSB	£11	0	

Complete Range Fabulous Moving Co
Ortofon Pick-ups.

AD Model Complete	£12	12	
A Model SAP LP	£18	0	
New Stereo SP Head	£34	5	

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ANSWERS TO CORRESPONDENTS

I. (Double View, W.A.) writes to congratu- us on the design of the stereogram de- ed in the April issue. At the same time, interested in amateur radio and would like ee some beginners' receivers and transmit- for the normal HF bands, described.

Thanks for the comments about the stereo ct. There has been a tremendous interest his subject lately and we have been devoting at deal of space to it, as you have no doubt ed. With television starting in States other New South Wales and Victoria, televison so a popular topic, so that the prospective amateur has had to take something of a seat. Rest assured that the subject has by heans been forgotten. In the meantime, the es on learning the Morse code and passing licence exam, should be of help to many of the local booksellers should be able to n a World Radio Amateur Call Book for Some of the booksellers in Sydney or ourne may even have copies in stock.

C.W. (Ravenshoe, Q.) writes to the Service- to suggest that a worthwhile step in the y of portable electric tools would be achieved overing the metal handles with some form sulation, such as plastic.

Many thanks for your letter and the sugges- it contains. We will pass it on the Ser- nan for his possible comments in future es. However, while we agree that the idea merit, we doubt whether the manufacturers ikely to be convinced as easily as all that. ight be a better idea if, in addition, you direct to several of the manufacturers. In regard, it is worth remembering that a letter es a 'good deal more attention than a 1 suggestion passed on to a traveller or nan.

C. (East Kempsey, N.S.W.) asks if we can y the circuit of a crystal set.

A simple and effective crystal set was de- d in the November, 1957, issue, copies of are still available through the query ser- at a cost of 2/6, post free. At your location, ould expect to receive only the local station with a big aerial tightly coupled signals d be strong and you should not have to about selectivity.

E.S. (Villawood, N.S.W.) makes some sug- ns for parts he would like to see made.

Thanks for your letter and for the sug- ns. The ideas may be good but not neces- practical in an economic sense. It costs a money and takes a lot of time to make or ferrite materials. A firm has to be very of the demand before going ahead, other- it runs the risk of serious losses on such We cannot see our way clear to publish em you have submitted.

name (Earlwood, N.S.W.) forwards a num- f queries for the Answer Tom feature.

Many thanks for your letter, which we shall r future use. Although the omission of name may be an oversight on your part, uld like to remind you that letters should he writer's name, not necessarily for pub- n but as a gesture of good faith.

(Belfields, N.S.W.) wants a universal am- to suit pickup, tape, and tuner inputs, and to know whether we have ever published ng along these lines.

Unfortunately, the information you have able to supply is very vague, H.J., making difficult for us to advise you. We have a of the power output required, the order lity or similar details concerning the ampli- oper, or whether you require the various to be mixed, switched, or used separately. r, we would need to have some idea as ether the output from the tape was cor- in regard to frequency response, and at evel it would be supplied. If you care us have some more details we will be to offer any advice we can, although we ll you beforehand that we cannot supply plete circuit for such a proposition.

(Queenstown, Tas.) has built the three or set of March, 1959, but is having separating the local stations.

Unfortunately, C.R., you omit to supply st vital piece of information concerning generative set, namely, whether the regen- circuit is working correctly or not. From ou say we are inclined to imagine that it and this would suggest that the reaction may have been connected back to front, you have a faulty transistor or other com- in the detector stage. In any case, try g the winding, if the set cannot be made late.

A.N. (Mount Hagen, New Guinea) writes to a modification to the ranges of the dis- meter, to provide logical db scales as the distortion percentage scales. The idea ermit the unit being used as a noise meter

Many thanks for your suggestion, A.D.N., will file this for possible use in the "Reader Built It" section. In the meantime, we will look into the idea more closely ourselves.

J.H.J. (Mitchelton, Q.) writes to complain of the various unethical practices which he claims are being practised by TV salesmen in Brisbane.

A. We agree, J.H.J., that there are always a percentage of unscrupulous types engaged in any venture, and TV undoubtedly has its share. At the same time we feel that not all the points you make are as serious as they might appear at first. Rightly or wrongly, 21in receivers appear to be the most popular size and, if the user is happy, there is not much point in trying to convince him otherwise. In the matter of fringe area sets most manufacturers make a standard set which is intended to operate over as wide a range of conditions as possible. The fact that they have rather more gain than appears strictly necessary does not automatically class them as "fringe area" types which, in fact, are rather special devices. It is true that unduly complex aerials are sometimes fitted, as you suggest, but there also are cases where it is genuinely necessary to use an elaborate aerial in order to eliminate ghosts and to use a pad to offset the higher gain which automatically goes with it. In any case, most modern receivers seem better able to cope with heavy signals than they were a couple of years ago. We will pass your letter on the Argument file for possible comment.

P.J.L. (Brisbane, Q.) writes to tell us of a recent experience with the Transistor 3 (March, 1959, we assume). From a holiday spot on Long Island in the barrier reef he succeeded in picking up the Voice of America broadcasts from the Philippines on the broadcast band. A small outdoor aerial was used.

A. Many thanks for the report, P.J.L., and we can readily believe that this was an exciting experience. Considering that the transmitter is probably a very powerful one, such reception is not unlikely under favourable conditions. However, it does indicate that the set is working as it was intended to and also gives some indication of just how good little sets of this kind are when they are properly built and handled. The reception of a nearby transmitter on 2550 Kc. is not unusual being in the nature of a "brute force" reception. It is likely to happen in any circumstances where there is enough field strength to force its way past the tuned circuits and it does, in fact, emphasise that these do have their limitations.

P.M. (Merrylands), N.S.W.) writes to describe some modifications to a crystal set tried by himself and some friends and which he claims gives greater sensitivity and selectivity than do conventional circuits.

A. In any crystal set a great deal depends on the components used with it, particularly the aerial and headphones. The purpose of the various tappings provided on a coil is to allow the best match between all components concerned and it would be possible for the best results to be obtained with the tappings you show. A great deal depends on the length of aerial used and the impedance of the headphones, and we suspect that you may be using crystal type earpieces. In the circumstances we doubt whether there would be any points in the circuit to suit other readers. (Incidentally, we feel sure that there is a mistake in your modified circuit, since we cannot imagine any set working with the phones and detector connected directly across a piece of wire!)

W.E.R. (Auckland, N.Z.) writes to express his appreciation of the magazine and to tell us of some of his experiences with the converter described in the June, 1955, issue. In particular, he describes a method of band-spreading he has worked out, being prompted by some of our remarks on this subject in the August issue.

A. Many thanks for your comment, W.E.R., and we are glad to learn that you derive so much enjoyment from your hobby. The bandspread arrangement is an interesting suggestion, the main point being the effect on linearity, which can vary a god deal with the proportion of series and parallel capacitance. We have in mind a few other ideas which we might be able to discuss at a later date, such as the tapping of the tuning capacitor down the coil. This has the advantage of using a standard capacitor.

C.G.McC. (Dunedin, N.Z.) writes to comment on the subject of voltage generating capacitors mentioned in these columns and the Serviceman pages some time ago. He offers a theory as to the probable cause, based on an article appearing in an American magazine just after the war.

A. Many thanks for your comment Mr McC and for the trouble you have taken to pass this onto us. However, we feel that the article to which you refer appears to be rather vague, since it would seem to require more than it describes in order to generate voltage. The simple fact that the impregnating wax was subject to potential difference while it was hot appears, on the face of it, just "too simple," and one is prompted to ask where is the "catch." However, we will certainly keep this suggestion in mind, and hope that someone else may be able to offer more details.

B.G. (Woy Woy, N.S.W.) wants to know what methods we would suggest to ensure a maximum of sensitivity in a receiver.

A. This is a very broad question B.G., and we could not possibly hope to answer all aspects of it in a reply of this kind. Radio receiver design is pretty well standardised these days and has reached a point where it is not particularly difficult to make a set which is sensitive enough to hear any signals which are strong enough to penetrate the prevailing noise level. In fact, many well-designed commercial sets having an RF stage (five valves plus a rectifier) are capable of this order of sensitivity and, once it has been reached, there is little point in striving for more. The real point of the matter is that it is usually noise, rather than receiver sensitivity, which limits the signal which can be received. Not a great deal can be done in regard to noise generated in the atmosphere, although improved selectivity, noise limiters, etc., may help a little. Noise generated in the set is another matter and careful design may be necessary to reduce this to an absolute minimum. In general the converter stage is the main offender and the use of an RF stage ahead of it is the main approach to the problem. Unfortunately, we do not know whether your question is prompted by a specific problem or simply as a desire for general knowledge, otherwise we might have been able to be more helpful.

Mrs K.W. (Brisbane, Qld), also GT. (Cardiff, N.S.W.) is anxious to obtain a book listing the call signs and frequencies of overseas short-wave stations.

A. We suggest you obtain a copy of the World Radio Handbook, published in Denmark by O. Lund Johansen. It is printed in English and should be available to order from the larger bookstalls. For more topical information we would refer you to the Short-wave Notes published each month in our magazine, which are particularly applicable to this part of the world.

Query service temporarily suspended

With the Editor overseas, it has naturally been much more difficult to maintain our production schedules and, at the same time, handle the very large number of technical queries which come to our office every day.

We were managing to keep ahead of the job until no less than four of our staff were taken ill, two being absent still at the time of writing.

In the circumstances, we have had no choice but to suspend the postal query service temporarily and to return letters and monies forwarded to us. The only queries, which we managed to cope with, were those requesting specific circuits, which could be identified and posted by non-technical personnel. We can only express our regret to those who have been disappointed.

As the staff position returns to normal, it should be possible to answer postal queries once more, or, at least, those which do not involve lengthy research or consideration.

Queries not requiring a postal reply will continue to be answered in rotation on this page.

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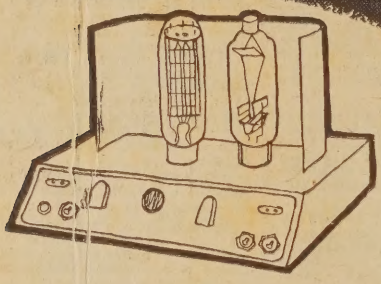

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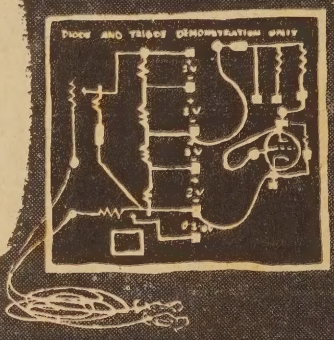

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nswers to correspondents

V.G. (Frankston, Vic.) is interested in stereo has built himself some equipment from cles in the magazine. However, he is puzzled an apparent contradiction in explanations re- ding the workings of a stereo record. Having pted the explanations we have given in the azine he received a pamphlet with a recent rd purchase which explains the system as g a vertical cut for one track and a lateral for the other. He wants to know, if this o, how a single stereo cartridge can handle systems, assuming they are being used.

The pamphlet you enclose does not specifically say that your record has been cut to the ical/lateral system. The writer's intention was ably to indicate that it used an adaptation this system but is not expressed at all . We don't blame you—or anybody else—getting the wrong idea. It is almost certain the record in question does use the 45/45 em. As far as we know the combined ver--horizontal idea did not progress much be- the experimental stage, so you need have ear that your cartridge is going to "tie itself nots" trying to handle both systems.

R.M. (New Farm, Qld.), writes a long, dly and interesting letter about his activities he radio field.

Thanks for your letter which has been pass- around the staff of our editorial office. The part requiring a reply is that about the tly heated output valves and if you wish void expense we agree that the 50 ohm re- r with the sliding tap may be a good pro- ion. Adjust the position of the tap for mum hum level.

A.K. (Kingswood, S.A.) writes to express appreciation of our transistor circuits and to some questions about transistor manufac- s.

We regret that we do not have the ad- es of the various overseas firms who make istors although, in general, it will be the r valve manufacturers in those countries A. in America, S.T.C. and Mullard in Eng- being typical examples. Locally, there are east three firms making and handling tran- s: Amalgamated Wireless Valve Co., Stan- Telephones and Cables, and Philips Elec- Industries. We suggest you contact these direct for data on current types. Many s for your suggestions and we will keep in mind. However, in regard to the ultra- ture types of receivers, it is fairly obvious we will have to wait until suitable miniature onents are available before we can do any- along these lines. You may be sure we tackle this just as soon as it is practical.

C.P. (Benalla, Vic.) is puzzled by the values d for the tuning capacitor used in the Audio l Generator of September, 1955.

Unfortunately, the value of 499 pf quoted he circuit is a misprint, and should read pf. The unit is the Philips type 4252, but other standard units probably could be used some alteration in the dial calibration.

. says that he has had good results from T. and H. 10-watt stereo amplifier and a l pickup. He was disappointed in a mag- cartridge, which he bought, because the pickup from the motor made it virtually sible to use.

We agree that it is rather dismaying—and sive—when problems like the one mentioned However, your suggestion that we warn s about such combinations is quite impra- from our point of view. Hum pickup is one problem: there are many other charac- cs which readers may regard as important, ightly so. A little thought will show the tude of the task which would be involved ting and assessing all the pickups, motors models, separately and in combination, for e characteristics which readers may want to about. Nor does the problem stop there. re frequently asked about combinations of ier units, bought and home-built, with pick- etc. We are asked about speakers and systems, separately and in combination, television sets and so on. In short, it be a fulltime job for a staff and laboratory ise and promulgate consumer reports of the ou suggest.

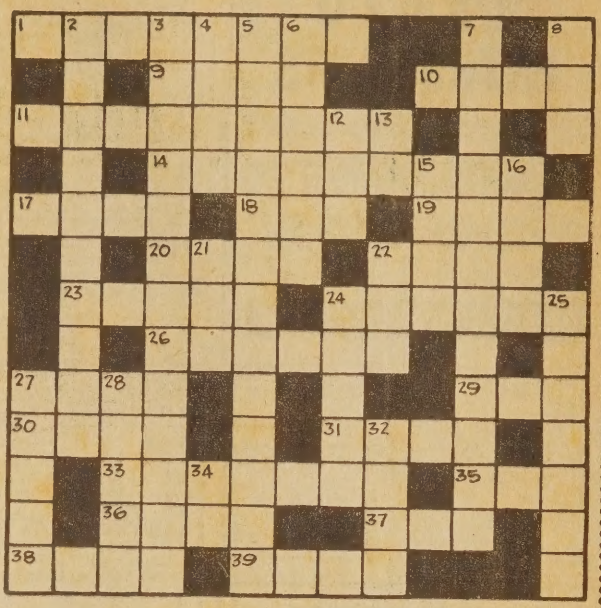
.Y. (Bellevue Hill, N.S.W.) writes to query rcuit of the Hybrid Car set in the June issue. He points out that the circuit ot agree with the wiring diagram on page rticularly in regard to the feedback circuit.

It is correct that these diagrams are differ- ut both are, in fact, correct. The wiring n on page 69 was an earlier form of the which, while quite satisfactory, was replaced t shown in the circuit after some further had been done. There is a slight advantage he latter arrangement, though not of any aching importance. The main point is avoids one more reactive component (the capacitor) in the feedback line.

(West Coburg, Vic.) asks whether we have lans to describe a 24in TV receiver or, still, a 24in fringe area design.

At the moment, the answer is "no" to both ns. However, that does not say that we ot do either or both. We simply have no iate plans in that direction. We have not red the possibilities of using a 24in tube he present 21in receiver.

THE R., TV & H. CROSSWORD No. 67



ACROSS

1. Loss in power mains.
9. Prevarica- tor.
10. Voltage applied to the grid of a valve.
11. Extending in all directions.
14. Customers
17. Gravel.
18. Single.
19. That which is woven.
20. Remain.
22. Brave man
23. Army group.
24. Father or mother.
26. Scoffs.
27. Strike.
29. Suitable.
30. A continent.
31. Bottom.
33. Moved.
35. Cry of dove.
36. Stead.
37. Consume.
38. Man's name.
39. Signify.

DOWN

2. Adulterations.
3. Pertaining to an electric charge or potential.
4. Face.
5. Frequencies in use for radio communication.
6. To rotate to selected position.
7. Treble loss due to input capacitance.
8. Tree.
12. Compass point.
13. A valve type suffix.
15. Urn.
16. A black wood.
21. An age.
22. Possesses.
24. An exploring instrument.
25. A type of valve.
27. A very soft wood.
28. A passage- way.
32. A British protector- ate.
34. That is (abbrev.).

Solution and further crossword next month

M.L. (Aboard Ship) objects to claims made during a recent industrial hearing in Brisbane for an award for television mechanics.

A: While the statements made are probably "over-statements," the nature of the work does call for a fair degree of skill and a lot of patience. It would be rather presumptuous for us to buy into the matter without hearing all the argument—particularly while a hearing is in progress.

J.B.M. (Rockdale, N.S.W.) has built our 35-watt PA amplifier, but is having some trouble with it. J.B.M. claims he is bothered by a high noise level in the first stage as well as a 100-cycle hum. He has made a number of observations regarding the gain of the amplifier and offers some suggestions for modifications to effect a cure.

A: The alterations you suggest and have made should be completely unnecessary, since the original amplifier functioned satisfactorily without the troubles you have described. You have not stated the sensitivity of the meter with which the plate voltage on the first stage was measured, but we tip that you used a standard multimeter of 1,000 o.p.v. sensitivity, which would explain the low-plate voltage reading you obtained. You have not stated the way in which you raised this plate voltage and can only assume that you did so by altering the value of the decoupling resistor or the plate load, neither modification being desirable.

Rather than toy around with alterations, we suggest that you tackle the immediate problems of hum and noise and their possible causes. First it will be necessary to establish the hum frequency. This may be done with the assistance of an oscilloscope. If the hum proves to be of 100-cycle nature, then a filter fault in the HT supply is indicated. A check of all the filter capacitors and decoupling resistors should reveal the trouble-some component. On the other hand, if the hum should have a frequency of 50 cycles, then the fault must lie in the components or wiring of the offending stage. The possibility of an earth loop must not be overlooked. The valve itself may be at fault, with a possible heater to cathode leakage or a grid to cathode short. An open grid leak, too, may easily be responsible.

Much the same remarks would apply to the noise problem. Noise may originate within a valve, in which case a replacement is indicated. Then, too, the plate or cathode resistors may be noisy and should be checked.

Regarding the latter part of your query, we have no detailed information on hand relative to sound columns or flares. For a modest outlay ordinary speakers housed in spun aluminium flares do a creditable job for P.A. requirements.

Last month's solution

C	O	N	T	R	A	S	T	■	S	■	■	■	■	P
O	■	A	■	■	E	A	R	P	H	O	N	E	■	■
N	E	T	W	O	R	K	■	■	R	E	V	U	E	■
D	■	I	■	P	O	I	■	I	■	A	M	P	■	■
E	G	O	■	P	■	■	■	N	■	■	E	■	■	■
N	O	N	C	O	N	D	U	C	T	O	R	■	■	■
S	A	W	■	S	■	■	S	E	A	S	O	N	■	■
E	L	I	T	E	■	■	U	■	N	■	U	■	■	■
R	■	D	R	■	S	P	R	I	N	G	S	■	■	■
S	T	E	I	N	W	A	Y	■	E	■	■	■	■	■
■	E	■	O	W	E	S	■	G	R	I	D	S	■	■
U	S	E	D	■	E	H	■	■	■	L	■	A	■	■
■	T	■	E	■	P	A	R	A	L	L	E	L	■	■

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